ELECTRICAL REVIEW

[ILLUSTRATED.]

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

(*Formerly Review of Telegraph and Telephone.*)

Vol. 6, No. 26. WEEKLY. | NEW YORK, SATURDAY, AUGUST 29, 1885. | $3 per annum. Single Copies, 10 Cents.

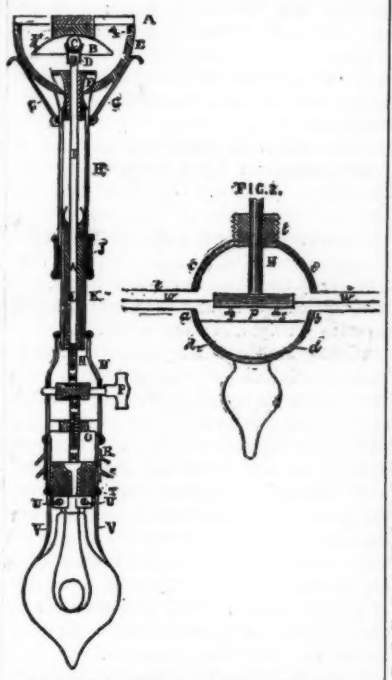
Copyright, 1885, by ELECTRICAL REVIEW PUBLISHING COMPANY, 23 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

A Telescopic Pendant Electrolier.

We illustrate a telescopic pendant designed by Mr. Grundy, electrician to the Royal Courts of Justice, assisted by his friend, Mr. Ready. This apparatus is constructed of two tubes, *H* and *K* (Fig. 1), sliding one within the other through a stuffing box *J*, similar to a cork slide gas pendant. These tubes, in connection with the ceiling plate *A*, form one electrode, the other being formed by the inverted cup *B*, (which is insulated from *A*), the ball *C*, and the rod *I*, which slides in an inner tube *L*. The pendant swings and rotates in a sort of cup and ball joint at *F*, the contact between the outer tube and the cup *E* being assisted by the springs *G G*, and that between the inner rod *I*, and the plate *B* by the spiral spring *D*, under the cup and ball *C*. A switch at *P* does away with the trouble and cost of running separate leads to some other portion of the room as is nsually done. A ceiling plate can be fixed in as many rooms as may be required, and the wires attached, and then the pendent can be moved from room to room as required.

The attachment, illustrated in Fig. 2, enables as many lights as necessary to be added or taken away by any unskilled person in a few seconds, and though those already made are capable of carrying six lamps taking one ampere each, still the apparatus does not look too heavy or cumbersome for a single-light pendant. There are no cords or pulleys to get out of order, and a short circuit is impossible. The drawing is only to show the interior parts, but they can be made as ornamental as desired. It appears likely to become a prominent feature in ship lighting as it seems particularly adapted to that service.



TELESCOPIC PENDANT ELECTROLIER.

The Question of Power.

ADDRESS OF MR. UPTON, OF JARVIS FURNACE COMPANY, BEFORE ELECTRIC LIGHT CONVENTION—FULL REPORT OF DISCUSSION.

We publish below the address in full of Mr. A. F. Upton, of Boston, delivered before the National Electric Light Association, Wednesday, Aug. 19, and the discussion which followed:

The President—"Mr. A. F. Upton, of Boston, will address the convention on 'Steam Power in Reference to Electric Lighting.'"

Mr. Upton—"Mr. President, and Gentlemen—My few remarks to-day will be more particularly directed to the construction of central stations for electric lighting for arc and incandescent. The first introduction that our company had in regard to electric lighting was made in the City of New York, in the first central station that was ever started in this country of the Brush system. That was followed by Mr. Morrison's company in Baltimore, by the Brush Company in Albany, and afterwards by the Boston Brush Company.

"Since then we have completed and thoroughly equipped all but three of all the central stations in New England, and partially completed and partially equipped stations all over the United States. We have stations in California and in the Southern States—in Mobile, Norfolk (Va.), and Canada; we have them, in fact, all over the country, and in some places outside. The principal thing to my mind in regard to electric lighting is the power, and then comes the cost of power. I have always claimed, from my own experience, that the matter of power in regard to electric lighting was figured in one sense on a wrong basis. My idea, in order to get at the bottom of electric lighting is, that the cost of power should be most carefully looked to. The only thing to be considered is the actual price per lamp per hour—not evaporation or pounds of coal per hour. It is the actual cost of running an incandescent lamp per hour. The first question that would come in in regard to that would be fuel. In selling lights you are selling power. That is always to be kept before the mind. In carrying out that line of argument I propose to state my own experience. Believing that electric lighting had come to stay, we devoted all our energies towards getting up the most economical plants we possibly could. We decided to use direct-acting engines; that is, direct belting, not using long-stroke engines. That was our experience in watching several stations at the start, and in the stations that we subsequently equipped we adopted the Armington & Sims engine. In regard to boilers, we have finally settled on using a plain steel tubular boiler. The size we are generally putting in now is 6x16, and 140 3-inch tubes, giving us 120 horse-power. At the Edison station in Brockton, Mass., with a boiler of that size and that engine, 150 horse-power, with 80 pounds of pressure. We have run at that station between 1,500 and 1,900 10 to 16 candle-power lamps of the Edison system. We used cheap fuel. In a test taken with a sectional boiler, it showed an economy of of 22 per cent. as regards using soft bituminous coal. The principal point we have made in regard to fuel was utilizing all kinds of cheap fuel, such as screenings, soft coal, slack, cinders from locomotives, saw-dust, cotton seed, waste, rice shucks. Anything that has anything combustible in it, whether wet or dry, we have used to good advantage. We have taken great pains to obtain our figures. In some cases I have got them; in others, not. There seems to be a reluctance among people to tell the figures. But the lowest I have is from the Thomson-Houston system, in Houston, Maine. They are running at a fuel-cost of two mills per lamp per hour. I found that the average cost on a station that we have fitted up has been, using screenings and soft coal, and using arc lamps, about four mills per lamp per hour. Incandescent figures I have not got. A test has recently been made where we partially fitted up stations on the Edison system. I have talked with a great many of the electric-light people, and I have tried to enforce my ideas that it is not evaporation, but the actual cost of the day or night's run that is wanted. If one man gets fifty cents, and another $3, why the man that gets the fifty cents gets the best results. In fitting up stations, I spoke of using direct-belting engines. We found, in making several tests, that the power used in driving shafting has run from 10 to 15 per cent. There are gentlemen in this convention who have a plant where it took 22½ per cent. of the power to run the shaft. There is a station in the city of New York where they have been shut two weeks from the breaking of the shafts. That can never happen where direct-belted engines are used Another point in running direct-belted engines. As a rule, not more than 100 arc lights are put on a circuit. Now, if those are run from one dynamo, or one engine, if one engine breaks down your whole system is disarranged. In fitting up stations I simply give what we use ourselves. We use Sheffield grates; we use the National heater, made in New Haven. Wherever we can we use the steam damper, keeping the pressure even and keeping the draft right. I would advise all to use, where tubular boilers are used, the steam cupola. I found that where slack coal or bituminous coal is used, it helps much in keeping the tubes clean. Of course that depends very much on the engineer and fireman. I found a great deal of difference in that. In every station we have put in scales for weighing the coal. All well-regulated mills with which I have any acquaintance, scale all their coal. I do not wish to enter into the question of electric lighting. That is not in my line at all. But we have done work for a considerable number of companies. I would like to speak of one system that is working now in the city of Lawrence. We have three engines in that station. We have just sold two 10x12 Armington & Sims engines, 90 horse-power each, to run a new system that is just in there, called the Municipal system. They run on that system four circuits of ten miles each. I am now talking of the incandescent system. These are thirty-two candle-power lamps. They contract for 500 of those lamps for $650. Now, it may puzzle you, but it puzzles the gas company still more, how they are going to do it. There is one other thing that has occurred to me several times, that I think the electric light companies should take into consideration, and that is the letting of power. At this same station a large number of motors are used, which run all day. They run from a half horse-power to five horse-power. Those motors are all employed, as I understand from the parties, at a good profit, and it has always seemed to me that everyone should use their power. You have it there, and why not use it? In the Thomson-Houston station the construction of the plant is so peculiar that I think I am justified in bringing it up before the convention. It was changed so that over the station a shoeshop has been fitted up. The shoeshop is run by the engines in the day time, and they receive as a rental for that power $2,000 a year. This is supplied by a 35 horse-power engine. It does not require quite 35 horse-power, because, while one engine runs the machine in the shoeshop, the other runs all the electric lights in the city. If all stations were built in that way, there is not one in the country but what would hold out a very handsome profit on the surplus power they might have in the daytime.

"Another point in regard to the station—there are two stations there. There is an Edison company started first and afterwards a Thomson-Houston arc system, and this is the result that is given: After the incandescent started, the sale of gas increased largely, and after the arc came in, it increased again ten or fifteen per cent. Now the question is asked, how did the introduction of so many arc and incandescent lamps increase the sale of gas? I can account for it in no other way than that when one store is lighted brilliantly by electricity, the next one has to use more gas. But my experience in New England has been that every gas company has increased its sale of gas as the arc lights have been introduced. I have spoken of a station partially erected and only partially equipped, where we set the boilers while the engines were being finished. That station was the first incandescent station that I ever examined. Instead of being under ground, it is all over head, and the station, as they informed me, has been paying a profit from the start. All gentlemen who start arc lighting, do their own wiring. Contracts were made for the year and payable monthly so much per lamp, every month, and the companies do the wiring. That, in my opinion was the cause of the success of the station. A gentlemen said to me the other day that it was not paying, and I said 'if any gentleman will go there and examine it carefully and look over the room, and if he says it is not paying a profit, I will pay his expenses.' The fuel costs eight and ten cents a ton.

"We have had some experience in regard to electric lighting and water-power in New England. But as a rule water-power has been entirely abandoned. The trouble has been that it is not reliable. In Manchester, the water has been very low several times in the last few years. In Lewiston and Holyoke it has given out altogether, and the stations there are entirely equipped with steam power. I understand there is a very successful station in Rochester running on water power.

"I should be pleased to answer any questions, so far as it is in my power to do so."

Mr. Duncan—"You said that the contracts were made for one year. Is there any objection to stating the basis upon which that contract was made?"

Mr. Upton—"I do not think I can answer that question. I think you would find out if you would go home that way."

Mr. Sperry—"This matter of cheap fuel in our western country, is a matter of vital importance, and I would like to ask what changes in the furnace are required to burn this cheap fuel?"

Mr. Upton—"It is done entirely without a blast. It is done by mixing with all slack coal or else three-fourths of anthracite and one-quarter of charcoal. The principle of the Jarvis on a smaller scale is the same thing as the Siemens furnace on a larger scale. The air is discharged over the fire and is heated in its passage. A great many people say that in heating the air you take heat from the furnace. But in heating the air you utilize gas that would otherwise waste. We use grate bars, fifty per cent. of air space. We set our boilers 28 to 30 inches above the fire. We have never had any trouble on any electric lighting station in New England that we have ever started. The Brush Electric Lighting Company started there I think nearly five years ago. I think they are using the same class of fuel to day as they used then."

Mr. Cleveland—"Mr. Upton referred to the use of water-power in running electric light plants in New England. They are using water-power at Holyoke, and Mr. Winchester is connected with the company there. I should be very glad to hear his experience in regard to running plant at Holyoke by water."

Mr. Winchester—"I did not expect to be called upon to say anything about water-power; but since Mr. Upton has referred to it, I will make some remarks upon the subject. I understood him to say that the water-power in Holyoke had all given out."

Mr. Upton—"I beg the gentleman's pardon; I said that I understood that it had stopped—not as a steady thing—the last few years."

Mr. Winchester—"That is true. There have been days now and then when we have not had it."

Mr. Upton—"That, in my opinion, kills it for electric light purposes."

Mr. Winchester—"We are using a thirty-inch wheel with a capacity of one hundred and twenty horse-power, and the price we pay for water is $300 for the day power and $150 for night power, paid every year; for night power, such as we use in running electric lights, it costs $150. The actual expense of running by water-power I could not give you exactly, because in our case we rent the power and it is already furnished by the water-power company, and they have all their wheels set. As compared with steam, of course the people there in Holyoke do not think there is anything like water. The actual cost of water is about one dollar a day for working days, for day power—that is, after the plant is once up. So far as electric lights are concerned, I would say we are running 103 arc lamps, Schuyler system, and we have made them up from the start. We let the city have fifty lights and we get fifty cents a light until midnight, and after midnight until daylight we charge fifteen cents extra. So all we are getting for an all-night arc lamp is sixty-five cents, and we use nothing but water-power, and have made it pay, so far. I think if any one will come up to Holyoke we can convince him that water-power is away ahead of steam-power, where you can get it. Where you cannot get it, of course you cannot have it."

Mr. Pope—"Are any lights running at Springfield, using the power at Holyoke? I understand that there is such a plant on foot."

Mr. Winchester—"No, sir; we furnish no power for Springfield lighting."

Mr. Ridlon—"At the Amoskeag Mill, at Manchester, they run about 170 arc lights by water power. The cost of those lights for running an hour, is $1.25 a thousand, equal to gas. For running at three horse it is about 70 cents per thousand, using their water power."

Mr. Upton—"One thing I would like to speak of; a station has recently been erected close to where I live. They are running ninety arc lamps on the Thomson-Houston system, 10½ by 12 inches, sixty horse-power. They do it at less than three dollars a night, for two. There is another station we recently equipped at Norwich. I would like Mr. Jepson to state just what it cost to run per night in his own way."

Mr. Jepson—"At Norwich we have a Jarvis boiler; it costs us for lights about four mills for fuel. We are running fifty-five lights now, and our coal bill last month was $34. To July 1st, we had run 106 days and our expenses were less than $13 a day for running the plant. We paid from the start a dividend of two per cent.; from July 1st we had made $550 odd. Our expenses were heavy on the start because we had a good many things to buy, and we had to experiment on fuel. But we now burn this bituminous coal, and pea coal. We pay $4 for the bituminous, and $2 for the pea coal. Our coal bill runs from $31 to $34 per month. We run fifty-five lights seven nights in the week."

A Member—"Do you run any day-light lamps at all, sir?"

Mr. Jepson—"No, sir; we start some lights at 4 o'clock and average about six hours a day running."

Mr. De Camp (of Philadelphia)—"The statement of the cost for coal in lighting is an interesting one to my company, and I understand that the statements that are made here, while they are in one sense practical statements, are very largely theoretical. I would like to know whether these statements are made up as the results of experiments. For instance, are they based on starting with a given number of lights, at, say, three o'clock in the afternoon, running them until 12? I can understand the figures if that is the case. But, as operating a large station, which is before the public as a corporation for business, you cannot always do just as you would wish to. For instance, in our station, we start at half past seven in the evening, with about 250 light, and then we put out and run the 175 lights until about half past six in the morning; the balance of those lights run until 10 o'clock. At, say, 3 o'clock in the afternoon we commence to put on light, say another hundred at 3, another hundred at 4; from 4 to 6, at the average season of the year, burning our greatest number of lights. In other words, the whole of our power is utilized for those two hours only out of the twenty-four. Now, at 12 o'clock we shut off another number of lights The balance of the lights run from 12 o'clock to day light, or six o'clock in the morning There fore we are running our plant for 24 hours, or 23 hours. Out of that 23 hours, we have a complete and full light for two hours. Of course during that two hours we are running with the greatest economy. Now, it is a very nice calculation, and very hard to get at for our general information. I think this method of making up our cost—I take the actual number of lights per day, or per month, and the aggregate amount of coal that has been used for that time—divide the number of lights into the pounds of coal, and it gives me the pounds of coal it would cost me per light during that time. I find that in making up our average run of lights, taking, for instance, the month of October, a medium month, our average time of burning all our lights would probably be ten hours. Now, dividing that into the number of pounds of coal that we burn, of course, gives us the number of pounds of coal per hour that it has cost us to run per hour. But, after all, it does not signify much; any more than a general estimate, and the only way that I could get at it is by watching it from day to day, and from month to month. Now, if there is any other station that is running on the same principle, that is running the full twenty-four hours, and they can give me the amount of coal that is used there per hour, the amount of coal that is used per light, I should be very glad to know it. I am asking that for my own information, so that I may see whether we are running under economy or not."

Mr. Jepson—"Our coal is weighed, every pound we use, and our carbon boy takes account of every hour that every light is running, and reports are made out of every carbon that is burned, so that we know every night how many hours a light is running, and how many carbons we use, and how many pounds of coal we consume. The Jarvis Engine Company has written to me once or twice for estimates of the amount of coal we are burning, and we have figured it in every way, and used every method we could find in order to run cheap, and to make money. Our customers only open for two hours a week for three months in the summer, and they want everything they can get. If they hire a light they want to own it. If they do not burn a carbon they want to be credited for it, so that we have to keep track to see how many carbons they do not burn. That is the way we keep track of our coal. We could not make it vary over four or five mills. Our man shuts off the lights at different places."

Mr. Upton—"In regard to testing, I know of only one way, and that is the actual cost of 24 hours' run. We have been very careful in all the tests we have made, and we have had every single thing brought in; taking the amount of coal used in banking, taking the amount of wood that is used, weighing the water—not taking any meter tests or guessing at the amount or anything of that sort, and when the power came to be taken on the engines, they were indicated every half-hour. If there were four or five stations each one was indicated; and, I would say right here, that I think very often engines are used with a great deal more power than the electric light people give them credit for doing. At some times it seems to me there is more resistance than at others. In regard to tests, as I said, I think the only way is to take the actual burning tests. In testing in mills we have changed that test that was largely used; it always used to be in New England pounds of water evaporated per horse-power per hour. We have brought that down in our tests to the total amount of water evaporated for a dollar's worth of fuel. Then every single thing will come under the same basis."

Mr. Ridlon—"I think I can answer Mr. De Camp's question. The Brush Electric Lighting Company, of Boston, are running a system very similar in regard to the matter of waste as that to which he refers. It is running nearly the whole twenty-four hours, and he estimated that he uses ten pounds of coal per hour per light, and that is on an average of running six hundred lights. That coal is buckwheat mixed with common at an average of about three dollars per ton. I would say this to the convention—that the public taking these figures, will get a very different idea of the cost of electric lighting from what it really is. We have taken one very small item. Our carbons cost more than our coal, as we all very well know. A great many things go to make up the electric lighting system, which add very much to the cost of producing light, outside of the matter of fuel. I thing the people at large will think that we must be making fortunes."

Mr. De Camp—"Those figures correspond with ours almost exactly. We make a written binding contract with parties to furnish light, from three till ten or twelve o'clock whatever may be their need. Yet, in mid-winter, or on dark days, those lights are frequently called on at two o'clock and sometimes as early as twelve o'clock. We comply with that demand as a matter of policy. If, for instance, on our commercial service, even though there may be a party on the circuits that may be without the lights, it would not be worth while to take out those lights. Therefore, when a day comes which we see is going to be dark for a couple of hours, we try to be prepared to give those parties light if they call for it. I have noticed in a case of that kind that if instead of running a full load between the hours of say four and six, in which our consumption of coal would be represented by three pounds, that we start up at twelve or one adding two or three or four hours to that day with that full load, then you figure up the cost of coal per hour, and instead of getting three hours, you drop off two and three quarters just for that short time. It shows that the question of utilizing your power or having a desultory business of using a part of the day, and only the whole of it for a very short time, makes a very great difference for the cost of coal."

Mr. Ridlon—"As you say, we want to get at this by the average cost of the month and charge it up to the different departments."

Mr. Duncan—"We run a station at Pittsburgh very much under the same conditions as the station Mr. De Camp describes at Philadelphia, and I can give him the data for two years. We run there right along, every minute in the twenty-four hours. We do not shut down on Sunday. There are very few lamps there that are required to be run on Sunday, and we accommodate those people although running at a loss during that day. But we want all the business that we can get, and that leads to other business; and there is not a time in the whole week, there is not a minute but what we are in operation. Of course, I havn't got those data with me; but the average is something less than Mr. De Camp stated. We have to keep the steam up all the time, and until within the last two months we have used soft coal. I can give the data to you when I get home."

Mr. De Camp—"There is another thing that might be said on that. I do not see why our business should be different from that of any other. There is certainly business that is more desirable for us to do than another class of business on account of the matter of running. But I have never yet found out with sufficient correctness which business pays us the best. For instance, whether our all-night business, our long-hour lights or our short-hour lights pay us the best. For instance, people come and say to us—and it is a very reasonable thing—I want a light for two or three hours. Now that of itself implies this: In Philadelphia, if a man wants light only two or three hours it is from the hours of say four to seven. Now, if that is the case it follows that if those are his lighting hours, for six months in the year he does not use the light at all. Therefore he says to me practically, what will you charge me for lights for three hours during the six winter months? Now, I have had as a matter of equity to our customers to make a graduated scale of prices, in which I fix a price for a twelve months' contract, a price for an eleven months' contract, a price for an eight months' contract and a price for a six months' contract. My six months' price is apparently a high one. It is as high as it is possible to make it; that is to make it higher would be to make it prohibitory. But even at that price and under those conditions I have declined to make any contracts for those short hours. It is a question with me whether that is a desirable business for me to do; whether that will afford us as large profit as running longer contracts for longer hours in the day at a less price."

Mr. Duncan—"We have had applications on that three-hour basis, and we refused absolutely to make a contract for less than six months. If a man wants a three-hour light for six months he pays the same as an ordinary half-year light."

Mr. De Camp—"Those are questions that will have to be met eventually in this business."

Mr. Sperry—"In Chicago we met with the same trouble, and it is always the fact that they want these small lights at the time our machinery is running the heaviest. We have been able to meet this to some extent by making contracts with a printing company there which starts its presses at twelve o'clock So that we shut down for about five minutes, long enough to make the changes in the connections and start up again. While this matter of power is before us, I would like to say that I have watched with considerable interest the trial and experiment, to some extent, that has been made in Chicago with our cable system. There they have overhauled their furnaces, and for the last six months have been engaged in utilizing the refuse from their barns. I find that data about this is very hard to get. As near as I can get it, I find that the expense is reduced about 40 per cent. Of course this power is not better adapted to running cables than to running electric lights or anything else, and there are barns in very State where this same refuse can be ob-

tained. If it really makes any difference in the cost of power it ought to be well considered. They started first by having grate bars a large distance from their boilers and then they had to add a blast operated by an oscillating engine, and a large blower, and now they mix a certain percentage with soft coal which they get at $2.00 per ton. I should think the mixture would be about one to five in weight, one of coal to five of this other stuff. It takes an additional fireman because the material has to be shoveled in constantly. I understand, furthermore, that this same device is being arranged to be utilized in Minneapolis or St. Paul."

Mr. Weeks—"I would like to repeat what has been said in regard to cost and to emphasize it. With respect to the cost of fuel, it is simply the cost of fuel per lamp per hour. If the public should get the idea that it cost only three mills per lamp per hour to run an electric lamp they would say that we are robbing them. I think that Mr. Upton made a very good point in regard to the connecting of the dynamo with the engine direct without the intervention of shafting. When I took charge of the plant that I am now managing, they had not only shafting but countershafting, and, as I demonstrated, were losing over twenty five per cent of their power. We have removed the countershafting and have taken steps to remove as nearly as possible the shafting, so that we will have our engines and dynamos connected directly, not by one shaft but by means of one belt. In regard to the cost of coal and the steam part of the plant, I think that is a matter of great importance. It comes right home to every one of us. That is where the solution must be made in regard to the commercial success of electric lighting. We must watch our coal pile. We must get competent firemen. We must have competent engineers, of course. We must have firemen who understand the apparatus that they handle, and the principles of making steam economically. They must know how to fire our boilers. We have a high setting of our boilers. Mr. Upton said that they set their boilers at 28 to 30 inches above the grates. We go beyond that. We set our boilers 36 inches above the grates. Our boilers are almost identical with those described by him, and I think that our results in regard to the cost of fuel per lamp per hour will justify the wisdom of the move. The data upon which I base this, are similar to those mentioned by Mr. De Camp and Mr. Ridlon, while our run does not correspond with theirs. We do not run the whole twenty-four hours. Still I think they could get some benefit from us in regard to this matter. We run from dusk until daylight; from candle-lighting to the putting out of candles; and we find that the cost per lamp per hour, taking note of the time when all of these lamps are put out—we put them out ourselves—and we have a record on our log-book showing exactly the number of hours we have run; this we foot up at the end of the month, and we know the total number of hours that have been run during that month; we know the total amount of coal that has been used, as we weigh it. From these data it is very easy to get the conclusion of three mills per lamp per hour, which is one mill better than the figures given by Mr. Upton."

Mr. Upton—"What is the cost of coal per ton?"

Mr. Weeks—"The coal we use is bituminous slack, and costs us five cents a bushel—about $1.50 a ton."

Mr. Upton—"I would say we have no one who is using a coal as cheap as that except at Harrisburgh."

Mr. De Camp—"We started with an 8×16 Porter-Allen engine, running eight 40-light Brush machines. The engines were run at 285 or 290 revolutions, and there is no question about the desirability of running in that way. But when we came to increase our plant, having that number of small engines in, and having learned in the first year—as, of course, was known before—that we could not run eight small engines of forty lights each with the same economy with which we run one large engine of the same capacity, but thinking that the question of safety would more than compensate for the saving in running the large engines—that was our principal reason for putting in the small engines. However, at the end of the year, when we increased our power, we put in a pair of 24×48 Corliss engines to run our lines' shafting. We had to run two lines of shafting, of course. With that engine we are running sixteen machines, and we do all our heavy work with it. As yet we have never met with any mishaps, and we have come to the conclusion that the possibility, under careful management, of a large engine breaking down or getting out of order is so small, that the question of safety by running direct does not compensate us, and it is quite probable that in the course of another season, unless we see some greater compensation for the increased expense of running small engines and running direct, we shall put in large engines."

Mr. Upton—"I would like to ask the gentleman if he has indicated the power on his direct-acting engines, and also what power it takes to run his line shafting."

Mr. De Camp—"Our friction load on our shafting—and I attended very particularly to this, because I sanctioned it on the recommendation of our engineer, against the judgment of a good many prominent people—we have 66 feet of six-inch shafting, upon which we run eight No. 8 machines. That shafting runs at 300 revolutions. The other shaft driven from that shaft is 40 feet, part of which is 4½ inches and part 3½ inches. Competent and experienced engineers object to that thing on account of the friction load, and, of course, we employ an engineer as we would employ a lawyer or a physician; we take his advice or prescription unless we have extraordinary reasons for not doing so. We can contrive, if we have the business, to put on that thing 800 lights. In order to determine the judgment and the figures of our own engineer, I have on several occasions had an outside man come in and make figures for me, and, while they never exactly agreed, they have not differed very widely."

Mr. Upton—"We have indicated in one place a 150 horse-power engine, where 22½ horse-power was used to drive the shaft—15 per cent. of the power. In another case, where they claimed that too much coal was used, we found that on a 50 horse-power engine it took 35 horse power to run the shaft. It is a common sense way to run the belt direct."

Mr. Weeks—"So long as you can do that, you can run those engines with this shaft economically. There is no question about that at all. I have demonstrated that in our own station. I think that will explain the economical results Mr. De Camp has got out of his large engine in Philadelphia."

Mr. De Camp—"We have eight Porter-Allen engines there, which are probably equal to any other engines of their size and class. We run five machines on our day load, and the question arose which is the most economical—to run the large Corliss engine, with a maximum of 800 horse, or the small engine, and we made a practical test of it, and we found it was economy to run the large engine even on that small load. That led us farther, and we found it was quite as economical to run the large engine on a load of 150 horse. The figures of friction as we were running loaded, as we found ourselves loaded at the time, were 85 horse-power. That included everything. That included the running of the sixteen dynamos."

Mr. Upton—"While we do use short-stroke engines, still, in a great many cases, we have used long-stroke engines, and, where we have used long-stroke and short-stroke together, we have taken out the long-stroke and put in the short-stroke in a small city where they have got to run to a long extent. But the question between the two of course, would not be decided on any one statement. Therefore, I do not think that while Mr. De Camp's tests were careful that they would be conclusive at all."

Mr. De Camp—"This is the first time that ever I heard the statement made of the friction of the shafting. I went at it as a matter in our own interest, and the conclusion I arrived at when it was reported to us was that, of course, there was power lost other than making lights; but I was told by the parties who were criticising that method of construction that it would take half of our power. That killed the thing. But when it took only less than 10 per cent., I thought those other things would compensate for that loss, and, indeed, I have never heard a statement until now from anybody of what the usual friction load of shafting was."

Mr. Ide, of Springfield—"We have two 80-horse engines, and we drive four machines with each engine—one belt right over the other. We have been operating three years in that way, and we get satisfactory results. We run a circuit from nine o'clock, and we run from 50 to 75 lights on that circuit. Our other engines have four 20-light machines. We run on that circuit from 60 to 75 lights. I have recently been putting in some plants at Chicago, where they use the belt direct, and we extended the shaft to the engine and put friction-clutch pulleys on the shaft. I think that is a very good arrangement. At very important stations it is a good plan to use two engines right and left, connecting them both to one main shaft with friction clutches, so that either or both engines can be used. This gives the advan age of using larger engines, as any number of machines can be driven direct from the main shaft, and any machine can be stopped or started when desired. This method of providing double power makes it expensive; but it provides a sure method of providing the lights at all times, for if either engine gets out of repair the second engine can be started and the other engine shut down, without interfering with or stopping the lights, and you handle the machines about as well as though they were driven by separate engines.

Mr. President—"I want to call the attention of the association to the fact that a large number of subjects are here for consideration. This entire morning has been devoted to the consideration of power. There are other questions equally important to be considered, so that, unless an objection is made, or some person has something important to say, I think it would be as well now to take up some other subject. It is past twelve o'clock, and two hours have been given up to the subject of power. Mr. De Camp, of Philadelphia, has given you, perhaps, the best practical comparative tests between small engines and large ones. As I stated at the Chicago convention, the Philadelphia case had done more toward settling this question than any other in the country. It is a place where both systems have been used in the same works. It is a place where the electric-lighting business began with the beginning of its history almost. They have experienced all the difficulties that any other station in the country has experienced. They have applied the remedies which experience and skill and result of experiments in other parts of the country have suggested. I therefore repeat here what I said in Chicago, that the Philadelphia case goes further towards settling this question than that of any other which has so far come under my notice. I have been asked to give the experience of our company in Baltimore. It would only take up time. It would be, to a certain extent, a repetition of what Mr. De Camp has stated, without having had the opportunity of making the close comparison that Mr. De Camp has had. We used some small engines, too, which were replaced with other ones, but they were all of the same type. We used one line of shafting in the beginning, 80 feet long, 4 inches at one end and 3½ inches at the other (I do not know what he does with his 6-inch shafting; I do not see any use in that). Upon that we ran originally three engines. We discarded that long line of shafting and cut it up so that each engine had its own load. We used the friction-clutch pulley; I won't say whose. We discarded the friction-clutch pulley as worse than useless. We paid $16,000 for that line of shafting equipped with pulleys. The shafting was made by the best mechanics in this country—Poole & Hunt, of Baltimore—recognized so by all machine-makers; and within eleven months it was out in the lot, and sold for three-quarters of a cent a pound; and we substituted the loose pulleys of the old fashion, cut the shafting in sections, and gave each engine its own shaft and its own load. We have put in larger engines. When we can increase, instead of putting in two 350-horse-power engines, we will put in one 500 or 600 horse-power engine. The result of our experience in Baltimore is against the use of independent engines for each machine. The result of our experience in Baltimore is in favor of large engines as against small ones, where you have the work, of course, for the large engine to do. I do not intend to take up the time of the association, I simply want to make these statements, which are merely repetitions of what I said at Chicago; and, unless there is something important to make in this direction, I suggest that we pass to some other subject."

Mr. Officer, of Council Bluffs—I would like to say just a word more, to attract the attention of others who are more familiar with the subject, than for any other purpose. We are using the Thomson-Houston system alone for arc lighting. We are using a Westinghouse engine, 11x11; 65 horse-power is what is claimed. We have a 14½ foot boiler, 62 flues about 3 inches each, and about 52 inches wide. We run at times, when required, three 25-lamp dynamos of the Thomson-Houston system; sometimes only two. I have been studying, since we have been running, the question of coal, and, of course, that means Iowa coal, and I presume that that means something different from the coals that we have had discussed here this morning. I have never used any other coal except Iowa coal, but I have used several kinds of coal there, and I get, I think, about the best that can be obtained in Iowa. I use a grate that is manufactured in the West. I cannot just at this moment recall the name. It is manufactured by a gentleman in Omaha, who is connected with the Union Pacific Railroad Company. It is what he calls a rocking-bar grate. For the purpose of using slack coal I put that in from the start, supposing that I would save thereby. I do not recollect the distance of the grate from the boiler; I think it is not over 18 or 20 inches. With that I have tried lump coal of the very best quality I could find, as well as the slack coal. I have used slack and a little higher grade steam coal, and then a little higher pea coal, and then nut coal, all from the same mine; as well as coal from other mines. I have found by experience that although this rocking-bar grate is claimed to be good for utilizing the cheap coal, that it is cheaper for me to use the third-grade coal. The slack coal for instance, I use at the rate of 14 pounds per hour per lamp while burning. The slack coal I am offered at $1.25 a ton. I am offered the steam coal at $1.50, and the pea coal at $1.75 for a year's contract. I have figured upon that very closely. When I am running thirty-four ten o'clock lights, and seven twelve o'clock lights—the ten and twelve are both running together—all arc lights, it requires nine pounds of that pea coal per hour per lamp, which I call a horse-power—2,000 candle-power lamps they are called. It requires then fourteen pounds of the slacked coal; whereas it requires only nine pounds of the pea coal. Recollect that is on the cars. It cost something in addition. It cost me really two dollars and two cents, delivered in the house, per ton of that pea coal. The other is one dollar and fifty-seven cents, delivered in the house, right at the furnace. It figures a difference of thirty-four cents per ton in favor of the pea coal in preference to the slack coal; so of course I use the pea coal. As to lump coal, although that costs three dollars, or three dollars and a-half a ton, I do not think that it is at all better than the pea coal. I do not know where the difference is, whether it is in the kind of engine or the kind of furnace, but I am certain of burning a great deal more coal than these gentlemen have named. As to applying that belt direct to the dynamo, we run sometimes three when we have a full demand, and sometimes two; most of the year only two of those dynamos are running. Now I find this difference; between the ten and twelve o'clock there are two hours to run. At the time I made the experiments only seven lights were running. It costs, then, about twenty-two pounds per hour per lamp. I do not know that I can enlighten you any more on the subject."

Mr. Weeks—"As I have had some experience with the practice of which Mr. Officer speaks it may be that in a few words I can give him some suggestions that will point out where he is in error. He says his boilers are set twenty inches from his bars. I think if he will raise his boilers about a foot and a-half, or very near that, that he will find that he will make a great saving in coal. In regard to the rocking-grate bar, I have investigated that matter very carefully. Under two boilers exactly alike, identical in their connections and setting, I compared them with the old style of grate bars, and I found with twenty per cent. less coal I got five per cent. more work with the rocking-grate bar. I made a careful test, measuring the water with meters and weighing the coal. Of course the meters are not absolutely reliable; but the Worthington meter is the best and that is the one I used.

Mr. Upton—"We have set since 1876 nearly three thousand boilers. We have tested very carefully the question of height and we have settled on a given height of from twenty-eight to thirty inches. We have set them as high as forty-eight inches, and down to thirty-six, twenty and eighteen inches. We have set boilers in the West fourteen inches above their grates. While thirty-six inches is too high for our fuel, it may do for soft bituminous coal. But I think the gentleman from Council Bluffs will help himself if he will raise that up as you suggest."

Electrical Review.

Published at 23 Park Row.

P. O. BOX 3329.

GEO. WORTHINGTON, - - - Editor.
CHARLES W. PRICE, - Associate "
LOREN N. DOWNS, - - - President.
C. C. HASKINS, GEO. A. HAMILTON, JOHN W. BEANE, } Consulting Electricians.

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance. Postage paid by publisher.

Great Britain and other foreign countries, $4.00, in advance. Postage paid by publisher.

ADVERTISING.

Transient, 25 cents per line, nonpareil.

EDITORIAL ANNOUNCEMENT.

Address all communications and make all checks and P. O. orders payable to order of ELECTRICAL REVIEW P. O. Box 3329, New York

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity and those engaged in Electric Lighting on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

Mr. J. Viennot, 150 South Fourth Street, Philadelphia, is our accredited representative for Pennsylvania.

Mr. C. C. Haskins, 118 LaSalle Street, Chicago, Ill. will represent the REVIEW in the West.

Messrs. Wm. Dawson & Sons, 121 Cannon Street. London, England, are our representatives for Great Britain.

NEW YORK, AUGUST 29, 1885.

CONTENTS.

	PAGE
A Telescopic Pendant Electrolier	1
Question of Power	1,2,3
Editorial Notes	4
Electrical Punkahs in Paris	4
The Electric Light in Europe	4
Long-Distance Telephony in Europe	4
General Western News	5
Book Review	5
Telephonic News	6
An Electric Fare Register	6
The National Self-Binding Insulator	6
Electro-Dynamic Induction	6
The Best Form of Dynamo	7
Placing Wires Underground	8
A Pointed Address	8
New Exposition at New Orleans	
Electric Light News	9
Electrical Patents	10

Four of the addresses delivered before the National Electric Light Association, and the interesting discussion on "Power," are given in full in this edition of the REVIEW. Should any of our readers desire extra copies, this office should be notified by telegraph, to insure receipt of order before the edition is exhausted.

The executive committee of the New England Telephone & Telegraph Company has decided to lease no more private line instruments unless the company has the care of the lines. Much objection to this is to be found in the daily press of Boston, where is published the opinion of several private line patrons who had made their own arrangements for the inspection of their lines and instruments. This decision, besides being an unpopular one with the telephone subscribers who use private lines, will inflict an embarrassment on those gentlemen who have built up the private line business in this company's territory, and who derive their revenue from it.

Providence, R. I., is a point not unknown to the telephone people; nor is the excellence of the clam-bakes of Mr. Eugene Phillips a matter of controversy. Therefore it is very probable that the attendance at the Telephone Convention to be held there September 8th will be large and enthusiastic. There will be an instructive diet for the mind, prepared by gentlemen of experience and ability who are closely identified with telephone interests, and a wholesome diet for the inner man, such as the coast of Rhode Island and Eugene Phillips have made famous. Every member should be present and come prepared to participate in both the intellectual and gastronomic branches of the entertainment.

The gentlemen named in connection with the presentation of proper matter for discussion at the next meeting of the National Electric Light Association should not neglect to commence their work promptly. These papers should be authorities. Even if commenced to-day, the time of the next meeting will be here before all points that each subject should cover can be proven and satisfactorily arranged. Let the earnest work commence *now*, and the week in Baltimore next February will be the complete success that it should be.

The price of New England Telephone stock has weakened perceptibly for the last week, while Erie has steadily advanced. We have always held that Erie stock was more valuable than New England as the contract and territory in proportion to capital was all in its favor. Erie management is trying hard to make itself popular, and is evidently succeeding; while New England seems going backward. With a united management the price of Erie ought to cross New England before another month.

ELECTRICAL PUNKAHS IN PARIS.

A striking difference between the Yankee and the Frenchman is that the former seeks the nearest way of accomplishing his object regardless of appearances, while the Frenchman, while seeking the solution of a mechanical problem, keeps his eye out for artistic effect. We Yankees can scarcely hope to compete with the Frenchman in scenic effect, though we have certainly outdone him in applied science.

Long since an American thought of and made electric circulating fans for restaurants, and small revolving spirals for desks.

So far as the large circulating restaurant fans are concerned, they are very ugly, though it must be said for them that they answer the purpose for which they were designed admirably. A Frenchman, however, has just constructed what in reality is a large fan, worked by electricity, which, besides doing a valuable service in hot weather, is pleasing to the eye. It is modeled after the "punkahs" so generally used in India. In the far East these punkahs are worked by natives, and require not a little strength to work continuously. One of them will keep the atmosphere of a small room in constant motion.

The electrical punkahs recently constructed in Paris are now at work in the grand restaurant Marguery, on the boulevard Bonne-Nouvelle, and they give great satisfaction. They are handsomely ornamented in the Indian style. This restaurant is situated upon the terrace of the Theatre du Gymnase, which M. Marguery has rented for the summer season. They are operated by a Gramme motor of seventeen kilogrammeters, and this receives the electric current of the dynamo generator, which is used for rinsing out empty bottles.

Now that these fans are at work, this restaurant is found to be the coolest in Paris.

THE ELECTRIC LIGHT IN EUROPE.

The question of electrically lighting the streets of London has been under consideration for some time past. At a recent meeting of the Commission on Sewers, the following was adopted:

"The Committee on Streets are charged to examine and to decide if it is desirable that the Sewer Commission undertake to furnish the electric light. It should arrange some limited district where experiments can be made, so as to get at the relative cost of light by gas and electricity."

After many long and at times acrimonious discussions, a poll showed that a majority of the commission were in favor of electrically lighting the London streets.

Several years ago, when the matter was first broached, it was seen, after a short examination, that the great expense involved made the enterprise impracticable; but now, since the recent improvements in apparatus and arrangements of installations have been made, and when many stores, shops, hotels and public places have repaid the companies for running their wires, it is thought that the electric arc system may be used with some show of economy.

At Turin, after many experiments made during the last Exposition, we learn from a French contemporary that the Municipal Council has decided to establish the electric light in certain streets of that city. This installation, which must be completed by the first of January, will be divided into two zones. In the first, the lamps will be fed directly by the dynamo machines. In the second, which is at too great a distance from the factories where the dynamos are placed, secondary batteries will be employed of the Gaulard & Gibbs type. The lamps, of the voltaic arc variety, will have an intensity varying from 800 to 5,000 candles, and the incandescent lamps will be of 50 candle-power. The cost of illuminating the city will be raised by this new movement from $16,000, the cost of gas, to $26,000, the cost of electricity. But, like all such comparisons, the mere setting down of figures is misleading. For though, as in this instance, the electric light costs a little over a third more than gas, it gives a luminosity of 70,000 candles, or *eight times more light than the gas* did. It should be said, however, that this great disparity between the relative cost of the two illuminants is in part due to the high price of coal at Turin, while, as we know, the same amount of coal, when used in the steam engine to work ten dynamos, will generate more light by electricity than could be looked for when used directly for making gas. In Turin only French coal can be had, coming from Lyons, where English coal comes by way of Genoa, and this makes the coal very costly.

Owing to recent accidents aboard the English war ships from explosions of gas coming from the coal bunkers, the Admiralty have decided to put incandescent electric lights aboard all steam vessels of the English navy. They were finally led to take this step by reason of the recent accident aboard the iron-clad Inflexible, in which a number of sailors were badly wounded. The gas from the coal bunkers was ignited by the naked lamp carried by the stokers, and a tremendous explosion followed, and this notwithstanding the care that had been taken to keep air valves in the bunkers.

LONG-DISTANCE TELEPHONY IN EUROPE.

There is much talk in France just now concerning two new microphonic transmitters. One is the invention of M. Hunnings, the other now on exhibition at Antwerp by the Societe Generale des Telephones, has been conceived by M. Berthon. The Hunnings telephone, though little known in France, has been of late introduced in Great Britain by the United Telephone Company, while in America it is the property of the American Bell Telephone Company. It is used altogether for long-distance service, for which it is peculiarly adapted, being what is known as a "loud speaker," a title it has assuredly earned by its service on the line between New York and Boston. In its construction grains of carbon are placed in an insulated basin, the bottom of which, being formed of a sheet of platinum, serves as an electrode; the other electrode is made of a slender sheet of platinum, before which one speaks.

The Berthon apparatus is dissimilar in many respects. It has two carbon diaphragms, which vibrate together. Upon the lower diaphragm there is a small ebony copel, filled with grains of carbon. The two plates are inclined to 50 deg., so that there is always contact between them and the grains of carbon. These two transmitters give excellent results in long-distance telephony, though the Hunnings apparatus is at times somewhat troublesome. After short usage the grains settle down, and communications become less and less clear. But this is easily remedied. No such trouble, however, is met with in the Berthon transmitter; its inclination of 50 deg., and, above all, the small quantity of grains necessary, a few decigrammes, does not permit of any settling. This apparatus possesses still another advantage. By reason of the recent modification in the telephone postal service, the telephone can be placed in any position which shall appear most convenient to the person using it. It is now placed in an articulated parallelogram, so arranged that it can be raised or lowered at will, while at the same time not changing the inclination which has been found necessary to its good working.

Among the many systems of long-distance telephony, that of M. Maiche seems, so far, to have found most favor with the French and Belgians. This system will soon be in running order between the systems of Lille, Cambrai, and Dunkirk. The popularity of this system is a result of its recent excellent working on the experimental aerial line between Paris and Nantes, and upon the underground line between Paris and Beauvais. In this system telephonic transmission can be kept up on the same lines, and at the same time as telegraphic, with which it in no way interferes. The telephonic circuit is entirely metallic, the telegraphic circuit terminating in the ground. The communications are perfectly clear and distinct, the signals for calling being distinct, the one from the other. To obtain these results M. Maiche worked with the ordinary telegraphic establishment as a base, and his system requires no rearrangement or disturbance of telegraphic apparatus. It is only the telephone which he makes submit to modification. The system primarily consists of the introduction into the line of a bobbin of unique construction. This bobbin and the helices are so arranged that the telephonic currents add to them, and the telegraphic currents neutralize them. The system of M. Maiche has assuredly much to commend it, because, though of simple construction and easily operated, it gives such good results.

Very soon this system is to be extended between Paris and Orleans, and later upon a a very large scale.

In Russia, the telephone is making commendable progress. In the last number of the *Journal Telegraphique*, of Berne, contains the translation of a Russian circular, addressed by the Russian Minister of the Interior to the directors of the telegraph, for the proper government of the telephone in the urban districts. This document, which was first distributed in April, 1883, seems to have been arranged with an eye to preventing the Nihilists from using the telephone, and is interesting now because it lays down the rules to be observed in regard to the Russian telephone, and fixes the rate of telephone service.

The right to use a private line is accorded to public and private offices only under the direction of certain officials; by clubs, and the members thereof; in hotels by the proprietors, and to those who reside permanently therein; in the custom houses, by the chief officials, also by persons constantly occupied there; agents and brokers, who have given notice in writing of their desire to become subscribers and users; to the officials of the Stock Exchange. The telephonic apparatus to be used for this private service by persons specially indicated, as above, must be arranged in a particular manner, and in such a way that they shall not at any time, or under any circumstances, be accessible to strangers. The bureaus of public telephone are installed at the Stock Exchange, in the railway stations, and at other points most convenient for the general public. The concessionary must ask authorization from the Director of the Telegraphs before the erection of any public telephone exchange. Those having a right to use the telephone are restricted in their intercourse through the telephone to those alone who are subscribers. The rates are fixed at 25 kopecks (20 cents) for every five minutes of conversation.

GENERAL WESTERN NEWS.

While the general public have a preconceived notion and a firm belief that once placed underground a wire becomes a permanency and requires no future looking after, the reverse is true by a large majority. Mr. Patterson, the cable man of the Western Electric Company, has a little museum of an interesting character, which shows some funny phases in undergound cable life. Two years ago or so, the Sectional Underground Company laid a quarter inch wrought-iron conduit of rectangular form, between the Postal Telegraph Office and the city limits south; into this the Western Electric Company put two Patterson cables of twenty wires each.

Last spring, a house-mover requiring something stable by which to anchor his windlass, drove a steel bar into the conduit, through one of the cables, cutting off about one-third of its diameter, and into the earth some distance below the iron box. The second cable was uninjured, being crowded away by the bar. One after another the wires showed leaks, and long after the mischief-maker had completed his task the hole was found and repaired.

In another locality on the same conduit, the gas people cut through the covering and the wires while laying a service pipe, although the cables were far below the level of their work.

Near Thirty-ninth street, a new sidewalk was ordered by the Council. The workmen found a means of torturing the two cables into a fair resemblance of a fish-hook full of angle-worms.

At one of the man-holes the wire men themselves used the cable for a step in climbing in and out until the pipe was broken.

The Western Indiana cable, where it crosses Clark street, was subjected to severe indignities by the railroad hands who cut and picked the box and cable, destroying several feet of it; and in the railroad yard, under the very eyes of the officials, ten feet were cut out and carried away, presumably to an old junk shop.

At the corner of Randolph and Dearborn streets a terminal was left at quitting time, to be connected and covered next day. In the morning the work of the lead-thief was apparent in the twisted and tangled terminal, yet the wires were all intact, having defeated the intended evil.

A section of submarine cable from Philadelphia is shown. The guard timber was removed to lay a second cable one afternoon, and the tare-sower came before morning, as of old. Tugs did it.

Somebody with more curiosity than wisdom opened a cable on the Ohio to test it. The hole was imperfectly closed, and the protecting armor which had been removed was repaired with "section boss," or hook and eye splices, and the armor looks to-day like a discouraged kite string.

The cable across Mystic river, Conn., revenged itself on the vandal who mistook it for an eel. In this there are several marks of a spear. The evidence of the cause is here complete, inasmuch as the tines of the spear were left sticking in the armor.

One piece is thoroughly flattened—a vessel in the Hudson river having got aground on and crushed it. Patterson says: "Call again, I will have more, probably, in a few days.

This list includes but a few samples which go to make up a large collection, but enough are given to show that under the most favorable circumstances their is proof that

> "Satan still some mischief finds
> For idle hands to do."

The underground conduits heretofore spoken of in these columns are very nearly all in. These are so distributed as to enable connections to be made from every other street, in each direction, each line of conduit furnishing facilities for the two blocks between which it runs. Prof. Barrett, our city electrician, has very wisely arranged for the placing of the balance of the city wires in these conduits, and the work has already commenced. The Professor believes in the physician taking his own doctor stuff as a guarantee to his patients, and accordingly down go the city's wires.

Starting from any given box on the south side, the wires will dive under the sidewalk, run to the nearest branch in the block, and thence into the main conduit. About twenty of these street blocks or squares, with their boxes, will be so connected in a few days, and then from the main river on the north to Van Buren street on the south, and from the lake to the south branch on the west, an area of about two and one-half miles square, not a city wire of any description will be visible above-ground. The north and west side wires will follow suit in due time, and the various other electrical wires will also go as rapidly as the companies to whom they belong can buy them.

When this is accomplished, the star-gazing individual who now perambulates our streets, making the pavement ring to the blows of his iron-shod feet, girded like some Spanish matador, his weapons—huge pliers and line connectors, his emblem of truth—the hatchet, his wire lariat resting lightly on his dexter shoulder, tie-wires half-bent, and ready for the garrotting act, dangling ornamentally from his waist belt; a bundle of batons, each decorated with a huge paste jewel, known to the fraternity as an insulator; his heavy boots bestrapped and decorated with instruments of torture worthy of the Inquisition, and with which he angrily stabs the poles, as, like the agile squirrel, he runs to giddy heights in the upper air, the envy of the groveling crowd that gaze in wonder at his daring—he, the athlete of telegraphy, will have then become, so far as city work is concerned, a memory in lieu of a presence. The bared and desolate poles will fall before the ax of an advanced civilization, food for the devouring teeth of the steel contractor's buzz-saw, in future to be spurned by the quadrupeds and crushed into nothingness by the wheels of passing vehicles upon our thoroughfares. So shall the end come quickly, and with it safety, peace and cleanliness.

Years ago, when a fire occurred for which there was no available "suspect," it was either charged up to the account of incendiarism or spontaneous combustion. With the spread of telegraphic systems, a new element of mischief was suddenly discovered, and the dangers of the wire, when opportunity offered, were heralded far and wide, until people really believed that the charge carried by an ordinary conductor was sufficient to sow death and conflagration broadcast in its wake, and—not half try.

Latterly, another bugbear has come to light—the electric light wires, whose death-range is considered to be far beyond the radius of either or those former murderous incendiaries, and no opportunity is let slip to fasten upon these the responsibility of every untoward accident.

That there is danger in improperly-installed electric light plants, cannot be gainsayed; and it is equally true that there are plenty of these to be found—especially where there is no legal supervision and penalty to compel proper installation. To make electric light currents and wires the scapegoat on every possible occasion, however, is unjust, and in contravention to that old maxim which accords to the nameless individual—popularly supposed to wear horns and split hoofs—his just dues.

The readiness with which the public news gather pounces upon the new light and its appurtenances was well illustrated at a fire in Chicago last winter, when the Grannis block was destroyed. In the basement a central plant was running, but there were no lights in the building, and the only wires were those running from the dynamo directly to and under the sidewalk to other buildings. The fire took place on the fifth floor, at a counter-weight shaft, the bottom of which was not nearer than eighteen to twenty feet from the dynamo and wires; yet the hue-and-cry was raised, and only after a thorough investigation was the public satisfied that the building was not burned by the electric current.

In the case of the death of an employe of the Western Electric Co. here, the public was loud and outspoken, and very positive that the death was caused by the current. Yet the testimony before the coroner's jury showed conclusively that, while there was a considerable shock resulting from the careless handling of the lamp while burning, death resulted from a fall to the sidewalk, occasioned by the unfortunate man losing his balance; and that, had the shock been received while standing upon the ground, the great probability is he would not even have fallen.

While Gen. Grant's body was lying at Mt. McGregor cottage, the house was struck by lightning, severely shocking several of those who were sacredly guarding the illustrious remains. With the natural perversity of that class of marplot newspapers who are inimical to electrical enterprises, the accident was at once attributed to an electric light wire, "which had somehow come in contact with" something or other, etc.

The facts in the case are that, either through imperfect installation or subsequent vandalism, or stupidity, the lightning-rod on the cottage was imperfect, and so, like thousands of others throughout this Continent—and elsewhere—the rod was an element of danger instead of safety.

The last case in point of date comes from the Montezuma Hotel, near Las Vegas, New Mexico, the burning of which "is attributed to the electric light wires becoming crossed and heated, thus igniting the woodwork."

The system in use in the Montezuma was incandescent, and, unless very imperfectly installed, would naturally carry but very little danger, so far away from the dynamo. The fire took place on the fourth floor of the building. In all the systems of incandescent wiring hereabouts, a fusible strip is inserted at every branch of the circuit, and the melting point of this is so low that before heat enough to do mischief by crossing is generated in the wire the safety strip is fused, and the current is cut off entirely by thus opening the conductor.

The crossing of the wires would hasten this action. The nearer the two were together the quicker would the safety device act in cutting off the supply of current.

But there were two electrical results accomplished that undoubtedly saved many lives. Tidings of the fire were transmitted by the thermostat line to the office of the hotel, and those in charge promptly notified every room in the house of the fact by means of the Western Electric Company's annunciator, which worked to a charm; and the inmates of 75 rooms thus reached the lower floors in safety, with all their personal effects.

The following telegram to the general agent here, from the manager of the hotel, gives the whole matter a very different aspect from that indicated in the press despatch the morning after the fire:

HOT SPRINGS, N. M., Aug. 12.

Telegram to C. C. Warren, 216 La Salle street, Chicago, Ill.

Press dispatch as to the origin of fire was erroneous and not official. Our opinion is that the fire was the work of an incendiary, and that it could not possibly have been caused by the United States Electric Lighting Company's system of incandescent lighting used throughout the house. This was demonstrated by the fact that the lights in all parts of the hotel continued to burn until daylight, wherever lamps were unbroken or wires unburned. There was also no indication at the dynamo of disturbance of any part of the system. All safety appliances worked perfectly. The presence of the lights in the rooms and corridors during the progress of the fire prevented panic among the guests and enabled us to work to the best advantage in fighting the fire and saving property. W. P. MESSERVE, Manager.

Chicago, Aug. 24, 1885.

Mr. Charles A. Rolfe, an experienced salesman, and a gentleman familiar with the electrical field, particularly the telephone interests, has accepted a position with the Western Electric Company, of New York and Chicago. Mr. Rolfe is a good man for this company to have, a pleasant gentleman and successful salesman.

BOOK REVIEW.

MAGNETO AND DYNAMO ELECTRIC MACHINES; with a Description of Electric Accumulators. From the German of Glaser de Cew. By F. Krohn; and specially edited with many additions by Paget Higgs, LL. D., D. Sc. D. Van Nostrand, 23 Murray Street, New York. Symons & Co., London, 1884.

This volume is the first of a series of monographs entitled the Specialists' Series, edited by Dr. Paget Higgs and Prof. Chas. Forbes, and treating mainly upon subjects pertaining to electricity.

The expressed aim of the work is "to impart information on recent technical subjects in a manner suited to the average individual intelligence," and, without doubt, it does not belie its pretensions. But, unlike the usual treatment, based on similar general premises, each subject is discussed without exaggeration and with a purely scientific spirit. The advance of electrical science during the past few years has been so rapid that much of the resulting literature lies hidden from the practical world in the nooks and cranies of society reports and the records of scientific discussion. To unearth, digest and so arrange this matter as to eliminate error, separate the chaff from the grain, that practical application may play its part, this is a task requiring special advantages for its performance, and which are happily possessed by the author. The introductory chapter is chiefly an historical review of the earlier types of dynamo-electric machines. Then follows concise but complete descriptions of the more recent types, bringing the subject quite up to date. Electrical storage is treated upon in a very clear and satisfactory manner, and the reader will be able, after reading the chapter devoted to the subject, to form a very correct estimate of the present status of the secondary battery as well as of its future prospects.

The physical laws bearing on the construction of electric generators and motors are discussed in theory and in their practical applications, and the absence of the sign of integration or differentiation from the purely mathematical parts of the book, is most certainly to be commended, Whilst the use of calculus is absolutely necessary in the solution of some of the problems arising in the dynamics of electricity, in the great majority of cases it is not so, and its employment is simply affectation and to be deprecated in books intended to reach the every-day, practical student. Special details are given in the construction and operation of electric light generators, and the subject of the construction of electro magnets and that of measuring instruments is entered into quite thoroughly. The whole concludes with an excellent abstract of the theory of the dynamo machine formulated in 1883 by Prof. R. J E. Clausius, and which has obtained extended recognition due to its scope and practical characteristics. This book will no doubt commend itself especially to the general reader who has learned to distrust the highly colored style of many of the publications on electrical subjects; and to the engineer for the practical information which it contains.

The Lowell (Mass.) telephone exchange is now using the number system of calls, and there isn't so much in a name as there was in the Spindle City.

The work of Mr. R. S. Garrett, of Baltimore, and Mr. H. D. Stanley, of Bridgeport, as assistant secretaries of the Electric Light Convention, was most commendable, and both gentlemen are entitled to the thanks of all the members for the prompt and efficient manner with which the business was conducted.

Mr. John T. Wheeler, general superintendent of the New England Telephone and Telegraph Company, has tendered his resignation. Mr. Wheeler has been in active service with this company for several years, has been a faithful and energetic official, enjoying the confidence of all the officers and employees of the company. The REVIEW wishes him success in whatever field he may labor in the future.

Telephonic News

*** Further telephone extensions are reported as being made in Scotland.

*** "Extra-Territorial" lines are being constructed in Belgium, telephone service being opened July 3d, between Ostend and the exchanges at Brussels and Mons.

*** The Electrical Subway Commission in New York has decided to receive plans for running wires under ground until Sept. 1. The companies have been ordered to file maps of their routes through the city.

*** There appears to be no hope that Mr. F. A. Gower, who recently made an ascent in a balloon in connection with experiments on air torpedoes, will again be heard of. Mr. Gower was joint patentee with Mr. Bell in the Gower-Bell telephone.

*** The directors of the National Telephone Company (Limited), England, have resolved to declare a dividend for the six months ending June 30th last, at the rate of 6 per cent. per annum on the preference shares, and at the rate of 2½ per cent. on the ordinary shares.

*** Speaking of time indicating by telephone, the *London Electrician* says: "One of the most useful adjuncts to the telephone service in America is an arrangement whereby any subscriber is enabled to ascertain the exact time of the day by simply placing his telephone receiver to his ear."

*** By the decree of the President of the Republic of France, subscribers to private telephone companies are now permitted to extend their communications through any of the public offices upon payment of an annual tax of 40 francs per annum in Paris, and 30 francs per annum in the provinces.

*** All the theaters of the city of Rio de Janeiro are to be connected with the central fire station by telephone lines. It is said that this step was suggested by the Emperor. The number of the employes of the telegraph department is to be increased, so that the electric fire alarms may be examined every day. His Majesty, the Emperor, is also credited with this new undertaking.

*** United States Consul Waller, London, continues to receive telegraphic inquiries from America respecting the probable fate of the telephone inventor, Mr. Frederick A. Gower, who has not been heard from since he made the balloon ascension some weeks ago in an experiment with the aerial ship for military purposes. Nothing new has been learned of Mr. Gower and all hope of his having been picked up at sea by a passing vessel has been abandoned.

*** To the average looker-on it would seem an easy feat for a lineman to scale a telephone pole. A professional gentleman took a wager of $1 the other day that he could don the spurs and reach the top of the nearest pole. After a time the most frantic efforts gave him an elevation of about ten feet, and then suddenly returned the climber to mother earth in a position more stable than graceful. Others in turn attempted the same feat, and all with a similar result, except that some, reaching a somewhat greater altitude, fell back with correspondingly greater velocity.

*** In the House of Commons, recently, Lord C. J. Hamilton asked the Vice-President of the Board of Trade whether Her Majesty's Government have had under their consideration, in the interests of science and of the maritime welfare of the country, the advisability of requesting Professor Tyndall to resume the position he recently occupied in connection with the Lighthouse Commission. Baron H. De Worms, in reply, said that in March, 1883, Professor Tyndall resigned the office of scientific adviser to the Trinity House, the Commissioners of Irish Lights and the Board of Trade. He had made no application to be reinstated in that position.

An Electric Fare-Register.

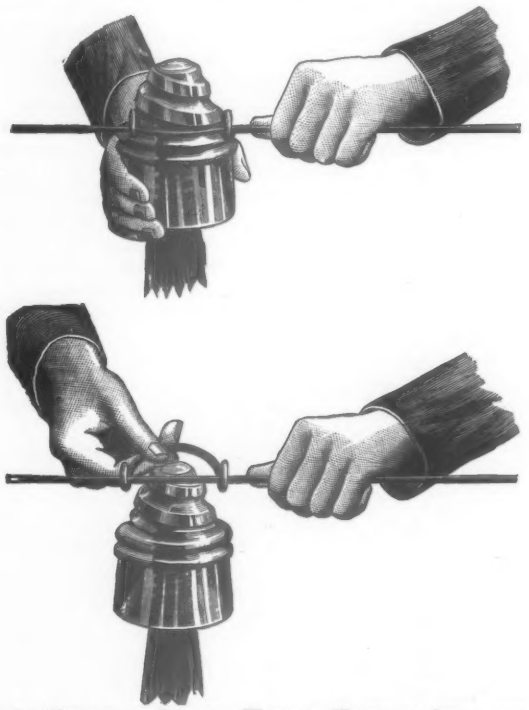
In March last a patent was issued for an electrical apparatus for the purpose of registering fares on street railway cars, and elsewhere, where rapid and reliable registration might be required. A syndicate in Boston purchased the patent a short time since, and have within a few days formed a corporation for the purpose of supplying the register to horse-car corporations, upon a royalty or otherwise; the policy of the company not being fully defined at this writing. The title of the corporation is "Boston Electric Register Company, and its officers are Richard M. Johnson, President, and George J. Morse, Secretary and Treasurer, with executive offices at 54 Devonshire street, Boston, where the apparatus is in operation.

Superintendents and master mechanics of street railways who have examined the appliance, speak of it as the best and handiest method of registration they have seen; and the President and Treasurers who have looked into it, feel that now they will have something that is too quick for the quick-witted conductors; as a treasurer of one of those corporations quaintly put it: "Lightning will beat the conductors every time." Its reliability is not doubted for a moment, as the push button opens and breaks the circuit, and the registration occurs only when the circuit is broken, preceded always by the ringing of the bell. The device certainly commends itself for its accuracy and convenience. In a future issue we hope to give a cut and description of this fare-register.

*** The factory of the Bell Telephone Company of Canada, located at Montreal, was badly damaged by fire last Thursday. The fire broke out about five o'clock in the morning, over the Bell Company's shop in the office of the Bank Note Company, and it is supposed originated in a spark dropped by the watchman. The machinery in the Bell Company factory is not damaged to amount to much, except by water, but the stock and fixtures, such as telephones, magneto-bells and supplies of all kinds, are so badly damaged that they cannot be used again. They are insured for about $25,000, which will probably cover their loss. The company had in stock 115 miles of hard-drawn copper wire, which cannot be put up, as it is annealed; about 450 magneto-bells, 150 hand telephones, and 175 Blake transmitters entirely destroyed, either by fire or water. Mr. F. Thompson has been appointed by the insurance company, and F. W. Harrington by the Bell Company of Canada, to act as appraisers on the insurance; Mr. F. H. Badger, of the Fire Alarm Company, of Montreal, to act as third party. It will take them two or three days.

The National Self-Binding Insulator.

This insulator, which is coming into particular favor with telephone and telegraph people, is now controlled in the United States by Messrs. Lytle & Co., of this city. The American Bell Telephone Company have decided to adopt them for their long line work, and other local companies are using them with very satisfactory results. This insulator is the invention of J. Slater Lewis, of England, and is being extensively used in Europe. It dispenses entirely with the old and troublesome tie-wire, being so constructed that the line-wire is applied and secured without the use of any tools whatever, and in the shortest possible time. It can be used in any situation, whether on curves, against walls, under bridges, on roofs, or wherever a tie-wire can be used. It is remarkably simple, durable and efficient, and may be removed or renewed with the greatest facility. It is constructed with a conical and expanding screw-thread upon the exterior of the upper portion, similar in form and principle to the point of a gimlet. The line-wire is attached by means of a rigid wire shackle or clip, formed in the shape of a horseshoe, the curved portion of which is adapted to encircle the body of the insulator at the base of the conical screw portion, while each end of the clip is made into a hook adapted to grasp the line-wire. The bell of the insulator below the point of support of the line is given the form shown by experience to be the best.



FIGS. 1 AND 2.—METHOD OF PLACING WIRE ON NATIONAL SCREW-TOP INSULATOR.

Besides the peculiar form of attachment for the wire, the National Insulator is provided with a perfect internal screw. It is formed by newly-invented molding tools of peculiar form; the greater sharpness and accuracy of the thread gives a better hold to the pin, and facilitates the operation of securing the insulator both to the main line and to the support.

The figures 1 and 2 show the position of the clip and line-wire when applied to the insulator.

The insulator having been screwed on the bracket or pin, give it three complete turns backwards after it has come to its bearing, and hook the clip on the line wire with the ends of the hooks turned upwards, as shown in Fig. 3, then drop the clip and line wire over the top of the insulator as shown in the same figure, after which the insulator must be screwed down on the pin as shown in Fig. 4. Care must be taken to see that the clip goes down the thread of the screw first with the line wire following it, the screwing motion being continued until the insulator comes to its bearing on the pin or bracket, when the attachment will be complete.

It will be seen that the insulator is secured to the pin or bracket, as well as to the line wire, by a single operation. In detaching the line wire this process is exactly reversed, the insulator is turned the other way, the line wire going up by the groove first and the clip following. Some linemen prefer to carry a pocket oil can, and before screwing on the clip they apply a single drop to the point on the clip, and also on the line wire which rubs against the insulator; friction is thereby avoided and the work made easier.

To replace a broken or damaged insulator of the common kind, it must be smashed and the pieces taken out, leaving the tie-wire attached to the line as shown in Fig. 5. The new insulator is then screwed on the pin or bracket as before, and the loop placed over the top of it, after which the operation is precisely the same as illustrated in Figs. 3 and 4. After a little practice the attachment may be made with great rapidity.

Electro-Dynamic Induction and Electro-Static Induction Between Conductors in Parallel Proximity.

There are two kinds of induction to which parallel conductors are subject—electro-static induction and electro-dynamic induction, otherwise termed electro-magnetic induction. As regards electro-static induction, which causes a retardation of signals, it does not occasion any inconvenience either to telegraphing or telephoning on short lines (say lines less than 50 miles in length), buried in the ground or submerged under water.

Electro static induction exists between a conductor insulated and buried in the earth, or in water, and its effects are so slight in short line wires that it may be entirely disregarded, but electro-magnetic induction takes place between adjacent parallel conductors, whether suspended in the air or placed under ground.

Mr. Wm. H. Preece, Electrician of the British Postal Telegraph Department, in a lecture delivered before the Society of Telegraph Engineers in 1879, "described numerous experiments upon wires running near to others conveying a current for electric lighting, and he found that the electro-magnetic induction set up, even at distances of 18 feet was enormous.

"The effects of electro static induction cannot be eliminated by any known contrivance; and as those effects in short underground lines, say of forty miles in length, do not interfere either in sending telegraphic signals or telephonic speech, it is useless to say more on that kind of induction."

As regards electro magnetic induction, the case is different, and its evil effects exist where a number of insulated conductors are placed close together, either in the air or under ground. Numerous devices have been suggested to eliminate entirely, or to minimize its effects. The records of the Patent Offices of the United States, England and France furnish evidence of hundreds of devices, said, by their inventors, to prevent induction, but it is well known that none of those devices eliminate, or even minimize, the effects of electro-magnetic induction. A careful examination of the various devices described in the reports of the Patent Offices of the countries above named, shows that in nearly every device the means employed, instead of diminishing the effects, intensifies them.

The device generally employed in these cases consists in enclosing an insulated conductor—or many insulated conductors—in a continuous metallic envelope in communication with the earth.

Other devices are to unite with the insulated conductors, another naked conductor connected to earth at several places, or at each end.

Others claim that perfect insulation of the several conductors does away with induction.

Many other devices are no better, but the fact remains, and cannot be controverted, that, at present, there is no known method of avoiding the evils of electro-magnetic induction.

The *Annales Telegraphiques* contains a paper by M. De Meaux, giving the results of a series of experiments made by that eminent scientist upon two gutta-percha-covered wires, the external surfaces of which were

insulated from the earth, and upon two such wires encased in lead, by means of which the external surfaces of the gutta-percha were connected to earth. The results, so far as regards the electro-magnetic effect, are summed up as follows:

"In a closed circuit the intensity of the current determined by the induction of a conductor upon another conductor, is not affected by surrounding one or other of these conductors, or even both of them, with a metallic envelope in communication with the earth."

Dr. Warner Siemens wrote that "the currents due to electro magnetic induction, instead of being diminished by the effect of the conduction contact between the external surfaces of the insulating coverings and the earth, become by this cause greatly intensified."

Practical tests of the numerous so-called anti-induction conductors, proves that none of them secure the desired results, and I have not been able to discover in any one of them any plausible theory that they would effect the results claimed for them, when due consideration is paid to the cause of the action of one electrified body upon another body.

When a body charged with one kind of electricity is placed near to another body, the electrical equilibrium of this latter body is disturbed, and will remain disturbed so long as the two bodies remain in the same relative position. This is termed induction by influence.

This disturbance of the electrical equilibrium is the result of the law that electricities of the same name repel each other, and those of the opposite name attract each other.

When several conductors, each forming an independent circuit, are near to, and parallel with, each other, and a current of electricity is sent through one of them, a current of electricity is induced in the other conductors.

The induced current is in proportion:

1st. To the intensity of the induced current.

2d. To the space separating the conductors.

3d. To the length of the parallel conductors.

4th. To the non-conducting property of the insulation.

Those being well established facts, what is there to avoid the evils of induction when an insulated conductor is enclosed in a metallic cover in contact with the earth? In this case the evils of induction are intensified.

When many insulated conductors are bound together with another central conductor connected to earth, what is there to prevent induction? The inducing current is always present, and the induced current must necessarily be produced.

Time will not permit me to review all the various devices suggested to get rid of the effects of induction by influence, and I confess that, among all the devices, I know of none that even mitigate the evil, and I shall be greatly pleased if you, or any of your correspondents, or others, will describe any method of avoiding this universal evil.

W. C. BARNEY.

Washington, Aug. 15.

The Best Form of Dynamo.

PAPER READ BY ELMER A. SPERRY, OF CHICAGO, BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AUGUST 19th, 1885.

A view of this subject allotted by our president, is rather a delicate task for one belonging to the rank and file of a dynamo builder The problem of dynamo construction is susceptible of a large number of solutions, each form being the "best" if our claims as manufacturers are accredited. There is no distinctive feature however from which something cannot be learned.

The art has advanced so far from the experimental stage, that to-day we are enabled to judge of the merits or demerits of a new construction from a practical standpoint, aided only now and then by theoretical considerations. We have learned by costly experience that not always is that dynamo which gives absolutely the highest electrical efficiency best for commercial results. We have found that the mechanical engineer cannot be ignored in the designing of electrical machinery; that the salient points in the best experience in construction of engines and analogous machinery should be closely studied and followed.

The best dynamo is that which with good economy operates continuously with the least expense; one that does not require the constant attention of an expert, by no means however, underrating efficiency in an attendant; one which has no delicate parts liable to derangement, one in which all the parts

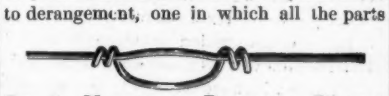


FIG. 5.—METHOD OF REPLACING BROKEN INSULATOR.

are accessible for cleaning and proper attention. Large journals, heavy framework and substantial construction throughout are not to be overlooked in dynamo machinery any more than in a locomotive.

A tendency which is becoming less prevalent has been toward developing the greatest possible current with a given size or weight of machine. The construction in this case is generally too delicate, and all parts are overworked to such a degree that they are constantly giving way. The effect of this upon the commercial operator and public generally has been disastrous, establishing the impression that all electrical appliances are inherently unreliable.

The later constructions are more durable, less delicate as to details and generally more satisfactory; although it is true they may occupy a slightly increased floor space. The armature being that part of the dynamo in which the current is primarily produced, it may be considered first in order. Its arrangement should be substantial, compact, and with as few irregularities as possible, which would tend to fan the air; yet be thoroughly ventilated, which is the most natural means of keeping down the temperature of the conductor. The core should in every case be laminated to prevent the generation of currents in the masses of metal. The armature conductors should not be too large for the same reason; and the mounting of the coils

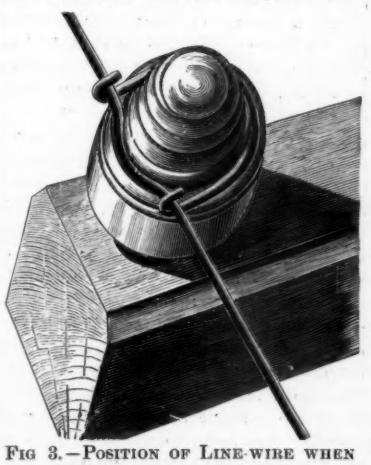


FIG 3.—POSITION OF LINE-WIRE WHEN APPLIED TO INSULATOR.

or armature conductor should be such as to avoid abrasion of the insulation from expansion and contraction or from centrifugal action in or upon the same. They should, moreover, be accessible in all cases for cleaning and repairs. These coils being the seat of the development of electromotive force, they should be so disposed that every portion if possible be subjected to the inductive influence of the field magnets.

I have taken special interest in this feature and find that the average in the forms of machines ordinarily cited as examples is less than 50 per cent. for that portion of each convolution of the generating conductor which is productive of electromotive force, the remainder not only being idle, but offering wasteful resistance to the currents set up in the useful portions. The immense importance of this point will be readily appreciated and requires no further comment here.

Waste space on the armature should not occur, although unavoidable in some forms, such as the disc armatures. The mounting and relation of the armature should be such in regard to the field that not more than two magnetic reversals occur with each revolution.

The winding of the coils one upon the other is found to interfere materially in case of repairs, and is sometimes a fruitful source of short-circuiting, but cannot well be avoided in the cylindrical or Siemens form of armature.

The divisions of the armature conductor into coils should be as numerous as is practicable, especially where the electromotive force is high, as it facilitates the insulation of the various parts from each other, and lessens the sparking and consequent wear and tear of the collector or commutator. Another effect of increasing importance is a tendency to lessen the indulatory character of the current generated, rendering it more harmless to life, and at the same time reducing its inductive effect upon adjacent line wires, which so annoy our neighbors (?), who, I regret to say, are not always charitably disposed. (The remarkable facility with which some of our worthy contemporaries

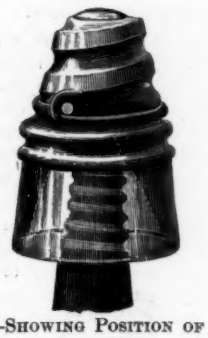


FIG. 4.—SHOWING POSITION OF CLIP.

either detect or imagine the effect of induction from electric light wires is only comparable with the sensitiveness of the instruments which they handle.

The commutator should be substantial, the insulation between the segments and at the ends should be ample, and of a character not liable to shrink, char, or absorb oil or moisture; the segments should be deep, to secure long service; the size should not be too small to secure proper electrical construction, nor so large that the friction of the collection brushes shall be felt, nor the centrifugal tendency on the segments operate to loosen them from their place.

The field magnets should be given special attention. Their arrangement should be that which would at once strike the practical mind as being the most natural. An effort should be made to avoid sharp angles or corners in both the polar extensions and the yokepiece at the rear.

The helices or coils should be of the most regular form, cylindrical being, perhaps, superior in point of economy.

The disposition of the quantity or masses of metal in the various parts of the field magnet should be also looked to carefully.

In some forms of machines a small core and coil may be found arranged to maintain the magnetic potential of a comparatively immense mass at the pole-piece. This arrangement is obviously bad. That form of electro-magnet most often met with in telegraph construction is, perhaps, of all forms, the best, and should be followed as closely as possible in designing fields for dynamo machinery. The arrangement of multiple coils parallel to each other for the magnetizing of a single pole-piece is adverse to high efficiency, as the adjacent parts of separate coils tend to mutually demagnetize each other. This effect should also be looked to with regard to the arrangement of other parts of the field magnets; often the polar extension and yoke, or any of the means by which the magnetic circuit is completed, are badly arranged as regards each other.

The arrangement of the field, as shown in the Gramme continuous current and Weston machines, that is, where the magnetic potential is developed midway in the length of the continuous core or piece of metal, labors under one disadvantage, which may be noticed as follows: Considering only one-half of the entire field of the machine, which would consist now of two coils, a north and south pole and yoke, we have the ordinary electro-magnet; and the opposite facing the said first set, although integral therewith, would perform the office of a keeper and tend to satisfy the potential at the poles.

The current in the two coils on the opposite side of the poles must then do the double work of, first overcoming this adverse tendency of the lines of force and magnetic potential, and secondly, of aiding in maintaining such potential at the poles. This result is of course mutual with regard to the two sets of magnets facing each other. The efficiency however, of this form of field is brought up to standard from the fact that only one half of the mass of the pole piece depends upon each coil or helix for the maintenance of its magnetic potential.

The distance between the pole piece and the surface of a revolving armature should not be too slight. Experience has determined that the increased efficiency is more than neutralized by the increased heating effect; the space is more valuable for keeping down the temperature of the conductor upon the armature and lessening liability to to damage resulting from a high rotative speed. Substantial bands should also be provided to guard against the latter.

It is of no little interest to note the changes marking the successive stages of development of any given machine as showing the effect of experience upon the more theoretical considerations, and bearings may be taken upon these successive stages which may guide the close observer in the selection of his apparatus, or the designer in the future development of any special form of dynamo machine.

A beautiful analogy may be traced between the distribution of the potential in the ordinary electrical circuit, and that in what may be known as the "magnetic circuit" of a dynamo. In the first the arrangement of the potential at various points depends upon the resistance encountered by the electric current at these points, varying in degree with the amount of such resistance. This law holds true also in the magnetic potential at various points in the magnetic circuit of the machine. Here, the points of greatest resistance occur at the space which is between the polar extension and the armature core and the degree of magnetic potential required at this point to perform the necessary work will be determined by the distance between the magnetic surfaces at these points. For the highest economy in the field therefore this magnetic circuit should be closed, and no space whatever provided between said armature core and said polar extensions. This, of course, being impossible, the aim should be as near an appro ch as is practicable, for reason that the cost of maintaining the magnetism of the field is the function of the degree of potential required at the pole piece, and when this is low, only a small amount of current is required to maintain the field. In this case, a large iron core with comparatively small amount of wire upon it, will suffice to do the work.

An erroneous idea, now going out of practice, has been to leave magnetic projections on the surface of the armature, which tend to short circuit and satisfy the magnetic potential of the field without compelling the induction to take place directly through the armature coils. The importance of as nearly closed a magnetic circuit as possible, was pointed out as early as 1878, by Lord Elphinstone, who, at that time, forecast the peculiarity which may now be seen as the result of practice and long experience in the art, viz.: the distance separating the armature and field magnet, the masses of metal, the efficiency at the field and general construction of the machine are determined by the character of the current to be developed; the greater number of convolutions and the greater thickness of insulation between all the parts of the armature coil and its supporting core in case of high-tension currents, requires a greater space for the coils, diminishing the size of the armature core and increasing its distance from the field.

The magnetic potential of the latter being therefore greater, its mass is lessened in both the pole-piece and core, with a proportionately large amount of wire, is required in the helices, and corresponding increase of energy required to maintain the magnetic potential. This peculiarity and difference may be seen in the two classes of arc machines, belonging respectively to the so-called high-tension and low-tension systems, and is even more readily apparent in the leading machines belonging to the two respective fields of electric lighting. This points to the fact that the internal efficiency of a machine varies with a certain function of the electromotive force of the current generated, being less for a high-tension machine and greater in a machine producing greater quality and lower electromotive force.

In electric lighting there are many other features of vital importance, aside from the mere electrical efficiency of the generator; for instance, the cost of construction of lines, the

distance at which the various operated devices may be maintained with economy, the economy of transmitting the current on the exterior circuit of lines, and possibly there also exists a difference in the transformation of electricity into light energy by the use of the voltaic arc—all, perhaps, in favor of the high-tension system; while the cost of maintenance, liability to leakage and attendant expenses, especially on underground systems, the danger to life and property and the economy of construction and facility in coupling, especially in the incandescent system, are decidedly in favor of the lower tension.

The preponderance of the advantages in either of these systems must depend entirely upon the circumstances and upon judgment of the investigator, no two plants being attended by exactly the same conditions.

The matters going to determine the best form of dynamo, as has been briefly pointed out, are so numerous, and the various forms of dynamos are best adapted each for its peculiar sphere, that a general formula, prescribing that form which is best in all cases, would be impossible. The art, however, has brought dynamo machinery, the construction of which at first was attended by so many difficulties of a high scientific nature, down to a sufficiently practical basis, so that good judgment with regard to ordinary mechanisms of a higher order are relevant to the more salient features, and may be depended upon largely in guiding those interested in investigating this class of apparatus.

Placing Wires Underground.

PAPER READ BY RALPH W. POPE BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, AUGUST 20TH, 1885.

There is no more important question before the electrical community of this city to-day than the underground line problem. Every branch of business requiring the use of pole lines must shortly be brought face to face with its actual solution. While there may be a difference of opinion as to the authority of the State to compel the abandonment and practical destruction of the overhead plants which actually exist, and which have been constructed in accordance with the requirements of the proper authority, there can be little doubt that the building of new aerial street lines in the future may, and probably will, be absolutely prohibited in the cities of New York and Brooklyn.

As an instance of the present state of affairs, I will call your attention to the dilemma in which the United States Illuminating Company finds itself to-day. This corporation shares the business of electric lighting for streets with the Brush Company in this city. Owing to the enlargement of the Grand Central Depot, at Forty-second street and the opening of Depew avenue, it was found necessary to abandon the Forty-fourth street station. A new station was equipped at the foot of Twenty-ninth street, East River, to which the lightning circuits were to be led when the machinery was in readiness. This change required the construction of a new fifteen-wire line through Twenty-ninth street—a distance of 3,600 feet. Upon application to the Commission on Electric Subways, a permit for this purpose was refused. I was informed by President Lynch that they would soon be turned out of their old station, that their customers could not be supplied from their other stations, and that nothing remained but for the commission to provide a method by which they could comply with the law.

I narrate this incident merely to point out to you the conditions existing here to-day. To show also that overhead construction is not entirely prohibited, I will read you the following item from the *Evening Telegram* of August 19th:

"*More Telegraph Poles.*—Gangs of workmen invaded West Twenty-eighth street this week and erected telegraph poles along both sides of the street, against the protests of the residents, who claim that according to the law recently passed the telegraph companies have no right to erect any new poles, and must put the wires underground."

The members of this association being chiefly interested in arc lighting outside of the territory embraced in the Daly underground bill, this subject is not in every case one of immediate importance. It is not at all improbable, however, that other and smaller cities may enforce similar legislation; therefore, it will be wise for you to consider the whole matter very carefully.

As you are, of course, aware, the burying of the existing wires in New York is a complicated engineering problem. Not only are there thousands of wires owned by various companies and individuals, but the different systems require different subterranean facilities. Curiously enough, the thunderbolts of the press have been hurled with the greatest force against the Western Union Telegraph Company for its apparent calmness in ignoring the requirements of the law. As a matter of fact, this company began placing wires underground ten years ago, and employed an engineer for the express purpose of preparing plans for a general system, which was to include at least the Western Union, Metropolitan Telephone, Gold and Stock and American District Telegraph companies. I understand this work had to be abandoned mainly because of the destruction of the gutta-percha insulation by the effects of the steam-heating pipes. The system adopted was that used in England—the simple drawing of gutta-percha cables through ordinary cast-iron pipes. A similar plan was recently put in practice by the Commercial Cable, popularly known as the Mackay-Bennett Cable Company. In the upper part of the city, however, the cable is simply buried in the earth, being protected by a line of bluestone flagging on the surface.

The Edison incandescent system, as you are doubtless aware, is entirely under ground and is too well known to require attention at my hands. It was planned with a view to the requirements of the Edison Company, but is apparently not suitable for all branches of the electrical service, so far as has yet been demonstrated.

I am not aware that any arc-lamp wires have as yet been placed under ground in this city, neither have I learned of any plan by which they were to be so treated. I consider this the most difficult part of the work, and the most expensive, on account of the large wires required, and the necessarily high potential of the currents used. In reply to a question: Is this feasible? I say yes; it must be. It may be an expensive method, and more serious objections may arise in practice than be anticipate, but it is foolish to regard it as an impossibility in this day of great engineering achievements. Its success requires plenty of dollars and plenty of sense. Furthermore, if arc lighting is to increase in this city it must be done, as no franchises for further aerial construction will be granted. As this crisis was bound to come, I think it was well timed, for the reason that reconstruction of the lines in this city would soon be necessary under any circumstances, and if lines must be abandoned it is less wasteful to destroy those already depreciated in value, and which should have earned their cost, rather than those which are in good condition. The lines of the electric lighting companies in New York are not of a permanent character. The poles are slender, and the fibrous covering with which the wires are supposed to be insulated may be seen hanging in threads from the weather-beaten structures, as you pass along the streets. I do know how long it was expected that these lines would endure, but they are apparently not long-lived. The cost of placing them underground is an expense which I presume our lighting companies are at present scarcely prepared to assume. It will naturally vary in different localities and under given conditions.

In the absence of any plans presented by the companies, the New York Commissioners will devise means by which conduits or subways will be prepared with facilities for accommodating the wires of all companies. It is to be presumed that they will then notify all interested parties that by lease or purchase they may obtain perpetual rights in such subways to place their wires. No system will be approved which is not sufficiently comprehensive to meet the demand for all classes of service.

This leads to the question as to what plan is the best, and this must be finally decided by the commissioners after examination of the various schemes presented, and their name is legion. I will not occupy your time by even calling your attention to the various theoretical devices presented, of which I understand there are over 250, as most of them can never be of any practical value, while but very few are in actual operation.

Of conduits which have been really used for this purpose, and have therefore been tested by experience, but two have been brought to my notice. These are the conduits which have been put down to some extent in Philadelphia and Chicago. The latter is known as the Dorsett Underground Conduit, and has been in use in Chicago for over a year. The same material has however been in use underground in the form of sewer-pipes for six or seven years without apparent disintegration. A conduit used in Philadelphia was troubled some time ago by explosions which arose from the accumulation of gas in the manholes. This was supposed to have been caused by leakage from the gas mains. While in Philadelphia last year I saw a line of arc lamps which I believe were supplied from wires through this conduit. With a little more time at my disposal I should have been glad to have looked into its details more thoroughly.

The conduit, as used in Chicago, appears worthy of attention as being the most successful system of this class which has thus far stood the test of experience, and may now be seen in actual operation occupied by telephone, telegraph, and electric-light wires. It is made of concrete, formed by mixing asphaltum and silex, and is moulded and at the same time hammered into lengths of about three and one-half feet, through which are formed at the same time longitudinal ducts the whole having the general appearance of a tubular boiler. One end is provided with a flange, so that the sections may be securely joined, when they are cemented with the same material applied while hot, and a perfectly tight joint formed. At the corners of the streets manholes are provided, formed by the same material. These, like the conduit itself, are gas, sewerage and waterproof. The material is said to have stood a Government test of 5,500 pounds crushing strain per cubic inch. It is also a practically perfect insulator, and the ducts are smooth and uniform inside, being about 2 inches in diameter. Mr. Callender informs me that he has drawn several miles of cable into them without any apparent damage from abrasion. This system was adopted over a year ago for the municipal wires in Chicago, and also by the Underground Conduit Co., of which Prof. Elisha Gray is President.

A recent experiment, which will, perhaps, be of interest to you, appears to have fully demonstrated the insulating properties of the concrete, which, being cheap, may possibly be practically utilized in this novel manner. The test, which was but an experiment, consisted in placing naked wires in one of these underground conduits for carrying electric light currents. The plant of 40 lights is still running successfully. While this proves conclusively that such wires may be safely run in the manner indicated, it was not intended to continue the arrangement permanently. The installation of the wires spoken of, where they are liable to dampness or other interference at the terminals of the pipe, was very complete, and the installation rendered very thorough by the following process, which is given for the benefit of those interested: The wire, before drawing in, was thoroughly taped from the union between the naked copper and the outside wire for a few inches at either conduit terminal into the pipe. A cork, slit to receive the wire, was then placed upon this latter and crowded into the end of the conduit about an inch. Then this countersunk space was filled with a compound which completely insulated the wire at the terminals of the tube, and made these air, water and gas-tight at the same time. As some of the members present may have occasion to visit Chicago, I would suggest that it might be worth their while to satisfy themselves of the merits of this conduit, as can be done most effectually by examination and inquiry on the spot.

Whatever conduit may be used, the individual insulation of wires is essential. The tests which have been made thus far with insulation for arc lamp wires, under these conditions, are exceedingly meager. A series of tests are now being made by the Standard Underground Cable Co., of Pittsburgh, which will doubtless be of value in this respect.

It is a peculiar trait of humanity that we prefer to profit by our own experience, rather than abide by the testimony of others. I would therefore respectfully suggest that such members as can do so, should, after careful consideration of the subject, undertake the construction of short experimental underground lines with a view not only to preparation for the future, but to ascertain for the benefit of the entire fraternity the best insulating material for subterranean arc wires. In cases where antagonistic legislation is threatened, the very fact that you are laboring in that direction may prevent your being forced to do so, hastily and against your will.

The burying of the wires in New York is a work of great magnitude, and should properly have been begun many years ago, in order that we might have thoroughly learned our trade, instead of undertaking so vast a job as mere apprentices in underground work. My brief intercourse with the Commissioners leads me to believe that they fully realize the importance of performing the duty which has been placed upon them, with a proper regard for the continuance of all classes of service without interruption. When the task is finally completed, and the wires working satisfactorily, with bills all paid, and dividends appearing regularly and frequently, we may be happier—I am sure we shall be older.

A Pointed Address.

The remarks of Mr. H. M. Cleveland, of Hartford, Conn., at the meeting of the National Electric Light Association, on the motion to appoint a committee of conference on the question of uniformity of prices for electric lighting, apparatus and supplies, were appropriate and comprehensive, and worthy of the special mention we give in this issue. Mr. Cleveland said:

"Of course, the committee cannot procure an association of electric light manufacturers or men who sell electric lights to a given tariff of prices, because circumstances vary both in the manufacture and the service. Now this question really illustrates the community of interests that ought to exist between the manufacturing companies and the sub-companies, because you cannot have a sub-company unless you have a manufacturing company and a manufacturing company is good for nothing unless you have a company to use the apparatus. Now Mr. Ridlon and Mr. Weeks have both touched the marrow of this question, which is that there ought to be such good-fellowship among the manufacturing companies of the country, at least so that the territory already operating should not be demoralized by competing companies. I mean by that, that when a respectable company is running an electric light plant in a place, large or small, giving good service at a fair price, it is not fair for another manufacturing company to go in and demoralize the market for the selling of light; putting in low bids, making valueless the stock of the local company that has been already created, and so forth. Now my experience about it is that the field is very large for electric lighting. I think that all the manufacturing companies of the country who manufacture a good system should have all the privileges they want, and I say what this association ought to do under that resolution is to try to create such a sentiment among all the gentlemen who are connected with electric lighting, whether as manufacturers or as consumers, that there shall be fair play and courteous business relations between the different interests of electric lighting. Now, I would say for one, that the company with which I am connected does not propose to go into the cut-throat business that my friend Mr. Ridlon refers to.

"We are not overrun with business, although we are very busy, but we propose to take virgin soil so far as we operate in electric lights. We have been invited over and over again to go into a contest in several places

where there are men a little disgruntled about the light, or the manufacture of it, or something of that kind, and who come to us and say: 'There is a chance; we will get up a company for you; make low prices to start with, and we will root the other fellows out.' We say, 'No; we do not want it; we want to go where they want us to come; we want to treat everybody fairly, and we want to have every other company treat us in the same way.' Now, if we do that, what would we do for the sub-companies? Here is a local company that has been created; stock has been distributed among the citizens paying a fair dividend, giving good service, and everybody is satisfied, excepting an occasional grumbler. Now, for a parent company to go in and demoralize that business field is not fair play. It does not show a fraternal spirit, and I am very ambitious that the electric-light business in this country shall be considered just as honorable and just as important and permanent as any other business in the country, and that the gentlemen connected with it the best men in the country, men of honor, men of brains men of energy, men of push. Now, let us have good-fellowship, and treat each other fairly; do as we are done by; manufacture our goods; organize our local companies and go on—not like the Goddess of Liberty enlightening the world, but enlightening our own country from corner to corner, from center to circumference; treating every man fairly, and making our electric properties—parent stocks and local stocks, just as desirable investments as anything that you can find in Wall street."

The New Exposition at New Orleans.

The managers of the new exposition at New Orleans, known as the North, Central and South American Exposition, and which will occupy the buildings of the late exposition, have invited bids for an electrical railway about the grounds. Many other improvements are in progress. Steam transportation has been secured from the central part of the city to the fair grounds, which have been cleaned and ornamented. The rates of transportation between New York and New Orleans will be reduced, it is expected, to $25 instead of $45, which was charged last season. The managers report that there is every prospect that the new exposition will far surpass the old, both in the volume and variety of exhibits. The managing director for the Middle States, with office at 234 Broadway, is Gen. C. H. Barney, formerly Adjutant-General of Rhode Island.

—— The fact is being gradually found out that, were the incandescent lamp in more general use in private houses, the long, hot summer nights might be spent to much better advantage than they now are. The morning newspaper office that is not lighted by electricity is wronging itself and its employes, particularly the compositors, for there is no work more wearing than to stand at the printer's case the long, hot hours of the night, suffering from the vitiated, gas-heated air, all of which is avoided by the cool, clear electric light.

—— On the occasion of his recent visit to the International Inventions Exhibition Mr. Gladstone remained for some time in Sir Francis Bolton's chamber in the tower. Mr., Mrs and Miss Gladstone tried their hands at directing the illuminations of the fountains by touching several keys, which brought forth certain colors in the water display. Mr. Gladstone made some pretty contrasts, but Miss Gladstone's combinations of colors were most satisfactory. Mr. Gladstone had the several plans of electric lighting of the gardens explained to him, and there was not a little fear lest he should by some mistake touch the wrong key and switch off the lights and leave the whole of the gardens in darkness. The fountain display gave the whole party great interest, and after spending over 20 minutes in Sir Francis Bolton's machinery room, a move was made to Old London, where the party remained some time, admiring the workmanship, the electric machinery room, and the grand entrance gallery.

—— At the last State Ball at Buckingham Palace the various rooms were lighted by electric light. The arrangement was on a larger scale than any previous attempt of the kind, was very successful, and gave much satisfaction. The total number of lamps fixed was 340, of which 280 were of 20 candle-power, and 60 were of 10 candle-power. The whole current for the lamps was supplied from accumulators placed in a tent in the garden, the cells having been brought, ready charged, from the works of the company at Millwall.

—— The contract for electric lighting awarded to the Schuyler Company by the city of Richmond, Va., is for 100 arc lights, or more, of 1,200 candle-power, on such streets as the committee may require, for the sum of $105.84 per light per annum, all repairs to be included in this sum; for furnishing private consumers with lights at a cost not to exceed $12 per month per light. The Schuyler Company were telegraphed on the evening of July 27 that they had been awarded the contract, and the following day they shipped the wires. The lights are to be placed on Broad street from Shafer to Twenty-ninth; on Main from Laurel to Twenty-ninth; on Twenty-fifth street from Main to Leigh; on Ninth from Broad to Main, and such lights of the one hundred not used on this route to be distributed in the parks. The Schuyler Company is a solid one, and will give Richmond an excellent light.

—— The electric light is superseding every other means of illumination in private houses where grand entertainments are given, and artificial complexions have gracefully adapted themselves to the change. Tempered by flowers and the many devices which taste and art employ to add to the effect of light and color, the electric lamp, or tiny globe of white flame, is now pronounced as becoming as the ideal wax candle. The considerate hostess always bears in mind the artificial complexions of her friends, and will see that the light is never too strong or fierce in her ball or supper-room. A story is told of a leader in society, who, on arriving at a certain great house one night, where a dance was in progress, instantly ordered her carriage to return, because she would not be subjected to the "vulgar electric glare" of the ball-room. Since those early days, this cool illumination has been tempered to the painted "lamb," and "everybody" is going in for the electric.—*Boston Beacon.*

—— It is very satisfactory to see that the subject of the electric light in coal mines is being taken up with vigor in Yorkshire, England, one of the Low Moor Coal and Iron Company's pits having been lighted by incandescent lamps. In this case not only are the main roads and pit bottom lighted, but the light has been carried right to the working faces. At the bottom of the shaft a main hauling road runs to the end of the pit a distance of some 150 yards, while parallel with this another road runs for the same length, turning off at the extreme end for about 130 yards at right angles. The working faces of the pit are reached by gangways running at right angles with these roads at distances varying from 50 to 60 yards. The dynamo, a "Blakey-Emmott" 2½ unit compound-wound, is fixed with a small engine at the bottom of the shaft, and the cables are run down one of the main roads, while branches are taken therefrom direct to the workings, passing first through a switch which is hermetically sealed. Sufficient slack of wire is provided outside the workings to enable the miner to place his lamp wherever it may be required. The lamp is covered with a thicker glass shade and also with a wire screen to reduce the risk of breakage to a minimum. Down each of the main hauling roads lamps are fixed and controlled by a switch at the dynamo, the facing lamps being controlled by the smaller sealed switch already named, so that each man on leaving work can turn his light out on reaching the main road. The work has been carried out by the Crossley Telephone Company, limited, of Albany Buildings, Bradford, which is devoting special attention to electric lighting.

—— The Jarvis Engineering Company, 61 Oliver street, Boston, have received an order to furnish an engine to run incandescent lights in the Conservatory of Music, Boston.

—— The Mount Vernon shops of the Northern Central Railway Co., at Baltimore, are to be lighted by electricity, and they are putting in a Ball automatic engine to supply the necessary power.

—— A Paris correspondent has grave fears of the artificial sun which the Society of Civil Engineers are considering for that city. This project, as we have before mentioned, is to place an enormous electric light on a column 1,000 feet high, which will have an intensity equal to that of 2,000,000 Carcel burners. The correspondent says: "What will be the result of so tremendous a localization of electricity has not, so far as we are able to learn, been studied out. It would be unfortunate if the grand tower, after it was completed, became a storm center of such magnitude that the climate of Paris should become worse than that of London, and the beams of the artificial sun should be perpetually obscured by black and lightning-vomiting clouds."

—— Mr. Kendall, one of the managing directors of the Peninsular and Oriental Steam Navigating Company, speaking at the trial trip of the latest addition to the company's fleet, said: "Sometimes I have heard the Peninsular and Oriental Company twitted with being very late in the field to adopt any new invention. When the paddle-wheel was superseded by the screw, we were said to be the last to adopt it; but we adopted it to very great purpose. The same has been said of the electric light, we will say. Well, now, a friend of mine took a passage on board an Atlantic liner which was fitted with the electric light when it first came out. I think it was one of the first ocean-going steamers fitted with that light. Everything was delightful for the first two days. On the third evening there was no electric light—there was no light at all; and no provision had been made for the light failing; but a few candles stuck in the ends of ginger-beer bottles were the only light enjoyed until the ship reached New York. Well, it has been our wish and hope—and I think our experience—to provide against failures of that kind. We have now the electric light fitted in a number of our ships, and on no single occasion has there been a failure."

—— A company has recently been formed in Turin, with workshops at Piossasco, for manufacturing the Cruto incandescent lamp, which gave such satisfactory results at the Turin Exhibition, and, from its efficiency, agreeable effect of light and durability, is establishing a permanent footing in Italy. This lamp was first brought before the public in 1882, at the Exhibition of Electricity at Munich. It is well known that various substances have been used for producing the filament of carbon employed in all systems of incandescent lamps. One company now uses a thin, flat strip of carbonized bamboo; Swan, a cotton thread, parchmentized in sulphuric acid, and afterwards carbonized; others, cardboard, silk thread, etc. Signor Cruto, on the other hand, has succeeded in producing a capillary tube of carbon by the decomposition of a gas rich in hydro-carbons, the carbon being deposited in a thin crust on a piece of fine platinum wire, which platinum is afterwards volatilized by passing a strong electric current through it, leaving in this manner a fine tube of carbon remarkably elastic and metal-like. In order to obtain a wire sufficiently fine, the platinum is first coated with silver; the compound wire is then drawn out as fine as it is possible, and the silver afterwards dissolved away with nitric acid, as in the process first introduced by Dr. Woollaston. In this manner, with an equal cross-sectional area of carbon filament, and consequently with an equal resistance to the electric current, Signor Cruto claims to have obtained a greater circumference, and consequently larger illuminating surface than is the case with the filaments of other makers which are not tubular. Another advantage claimed for this lamp is that the quantity of electricity required for one of 16 candle-power is 25 per cent. less than by other systems.

ELECTRIC LIGHT NEWS

—— There are 713 arc lamps in use by the city of New York.

—— The London technical journals think we are on the eve of important developments in the application of storage batteries.

—— The engine-men were well represented at the Electric Light Convention. The power improvements have been varied and numerous, as the unexpected demand the electric light has created in this field of manufacture has made them necessary.

—— The Newburgh (Mass.) Electric Light Company, using the arc light system, and which was granted the privilege of erecting poles and stringing wires through the city by the Common Council at the last meeting of that board, expect to complete their arrangements and commence work in a few days.

—— The gentlemen interested in the organization of an incandescent electric lighting company at Kansas City, are: Col. Kersey Coates, Mr. Wallace Pratt, Mr. W. H. Winants, Mr. M. A. Potts, Mr. M. W. St. Clair, Mr. E. D. Fisher, ex-Alderman J. H. Reid, Col. A. A. Tomlinson, and Mr. J. W. Phillips.

—— After the 15th of September, the electric light apparatus in the lighthouse at Cape Gris-nez, which gives an alternate white flash and eclipse of 30 seconds' duration, will be replaced by a larger apparatus flashing three white rays and one red ray. The three white rays will be arranged so as to follow each other with great rapidity, there being an interval of about 12 seconds after the third flash, and in the middle of this—that is to say, at the sixth second—the red flash will appear.

—— The cold air stores in Charterhouse-buildings recently built in London, are lit throughout by the electric light. The official trial of this installation has just been completed, and the conditions, which were somewhat unusual, as regards the accumulators, were amply met. The cells were to be capable of working a proportion of the lamps for sixteen hours, to be recharged in eight hours, and then supply the lights for sixteen hours, the dynamo being driven from the air compressors.

—— The late Chinese Minister to Berlin, in the early part of the month of June paid a visit of inspection to the forts and torpedo stations on the Canton river. Some good target practice was made with the 21 and 24 centimeter guns, and the large electric search lights of 36,000 candle-power, the largest in the East, were exhibited both at the Bogue Forts and at Whampoa. His Excellency congratulated Mr. Betts, A. M. Inst. C. E. on the successful defence made of the Canton river, by which Canton had been spared during the late war.

—— Two years ago, says a correspondent, I had occasion, during a period of idleness of my mill, to take down the belts and thoroughly oil them with mineral oil after they were well washed. But on attempting to place the belts on the pulleys again, I found that all of them had shortened to such an extent as to necessitate the insertion of a short piece into every one, which could be taken out again only after a certain number of working days. As this manipulation was anything but pleasant, and occasioned loss of time, I think it will be found more profitable if the belts are kept on the pulleys during the cleaning and oiling process. The dirt and gum can well be removed by means of a blunt knife or a coarse brush, and, when the belt runs slowly over the pulley, the inner side can be oiled with ease by means of a brush. If a belt so prepared should slip a little when freshly oiled, that need not occasion any alarm, as it will stop as soon as the oil has penetrated into the leather, and the co-efficient of friction is not endangered. I use for the purpose the common machine oil, which can be found in large quantities in every market.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING AUG. 18, 1885.

324,358 Telephone switch; John A. Cabot, New York, N. Y.

324,369 Electrical annunciator; Robt. Edwards, New York, N. Y.

324,381 Railway telegraph; Edward B. Ives, New York, N. Y., and Charles W. Williams, Cave City, Kentucky.

324,410 Connector for electric batteries; Gustav Otto, Jersey City, N. J.

324,412 Hydrostatic testing machine, for testing telegraph cables; William R. Patterson, Chicago, Ill., assignor to the Western Electric Company, Chicago, Ill.

324,413 Terminal for electric-light cables; Wm. R. Patterson, Chicago, Ill., assignor to the Western Electric Co., same place.

324,447 Electrical apparatus for the propulsion of vehicles; Frank Wynne, Westminster, England.

324,470 Electro-magnetic car brake; Edward B. Hess, Louisville, Ky.

324,475 Galvanic battery; Wm. T. Lyman, Ansonia, Conn., assignor to the Ansonia Brass and Copper Co., same place.

324,476 Electric railway controlling system; Chas. A. Mayrhoffer, Vienna, Austria-Hungary, assignor of one-half to Carl Diener, same place.

324,501 Regulator for dynamo-electric machines; Elihu Thomson, Lynn, Mass.

324,502 Electric arc lamp; Elihu Thomson, Lynn, Mass.

324,530 Holder for incandescent electric lamps; F. M. Brown, Boston, assignor to Nelson S. White, Canton, Mass.

324,551 Method of temporary electric lighting; Lazarus Göldenberg, New York, N. Y.

324,566 Current regulator for dynamo-electric machines; John A. Launert, Cleveland, Ohio, assignor to the Buffalo Electric Works, Buffalo, N. Y.

324,591 Telephone system; Charles W. Price and Albert Barrett, Kansas City, Mo., assignors to the American-Bell Telephone Company, Boston, Mass

324,597 Secondary battery; John S. Sellon, Hatton Garden, London, County of Middlesex, Eng.

324,621 Electric elevator; Schuyler S. Wheeler, Newburgh, N. Y.

324,635 Electrical indicator; Murray Bacon, Philadelphia, Pa., assignor to the Novelty Electric Co., same place.

324,658 Electric process of smelting ore for the production of alloys, bronzes, and metallic compounds; Eugene H. Cowles and Alfred H. Cowles, Cleveland, Ohio.

324,659 Process of electric smelting for obtaining aluminum, Eugene H. Cowles, Chas. F. Maberry and Alfred H. Cowles, Cleveland, Ohio.

324,666 Regulator for dynamo-electric machines; P. Diehl, Elizabeth, N. J.

324,667 Electric motor; P. Diehl, Elizabeth, N. J.

324,678 Electrical contact point; Ezra T. Gilliland, Boston, Mass.

324,692 Insulator for securing telegraph and other wires; George W. Hill, Quincy, Mass.

324,708 Galvanic battery; Edwin F. Leighton, Boston, Mass., assignor of one-half to Jas. Serson, same place.

324,711 Telegraph cut-out; Charles H. Lothrop, Lyons, Iowa.

324,726 Telephone transmitter and relay; Thos. J. Perrin, Brooklyn, N. Y., assignor to the National Improved Telephone Company, New Orleans, La.

324,727 Telephone transmitter and relay; Thos. J. Perrin, Brooklyn, N. Y., assignor to the National Improved Telephone Company, New Orleans, La.

324,728 Telephone transmitting apparatus; Thos. J. Perrin, Brooklyn, N. Y., assignor to the National Improved Telephone Co., New Orleans, La.

324,729 Telephone transmitter; Thos. J. Perrin, Brooklyn, N. Y., assignor to the National Improved Telephone Co., New Orleans, La.

324,746 Magneto-electric telegraphy; Fred H. Brown, Fort Worth, Texas.

324,752 Dynamo-electric machine; Holbrook Cushman, New York, N. Y., and Joseph P. Hall, Oldham, County of Lancaster, England.

324,774 Electric car brake; Charles E. Jones, Cincinnati, Ohio.

324,778 Arc lamp; Osborn P. Loomis, Lynn, Mass.

324,792 Electric arc lamp; Albert B. Worth, Brooklyn, N. Y.

Subscribe
FOR THE
ELECTRICAL REVIEW.

If you care for COMPLETE and RELIABLE electrical information, the Illustrated ELECTRICAL REVIEW, 23 Park Row, New York City, is THE PAPER FOR YOU. Price, $3.00 per year.

Particular attention paid to the wonderful advance in Electric Lighting.

PAINE & LADD,
HALBERT E. PAINE, Late Commissioner of Patents. | STORY B. LADD.
Attorneys in Patent Causes And Solicitors of Patents.
WASHINGTON, D. C.

SUNLIGHT CARBONS!

MANUFACTURED BY THE

PARKER-RUSSELL Mining and Manufacturing Com'y,

711 Pine Street, - - - - - - - - - St. Louis, Mo.

100,000 CARBONS PER WEEK.

Using the purest materials and with machinery of our own invention,

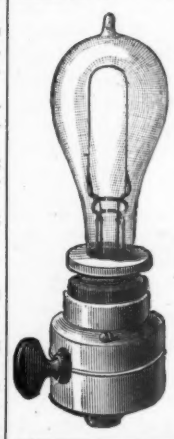
Every Carbon is manipulated separately from the beginning of the operation until finished.

They are, therefore,

ABSOLUTELY UNIFORM AND EACH CARBON ALIKE IN ALL ITS PARTS.

In straightness, length of time in burning, brilliancy and steadiness of light they excel all others, and are adapted to the various systems of lighting in use.

— EDISON —
ELECTRIC LAMPS



½ TO 16 CANDLE-POWER.

SURGICAL AND DENTAL LAMPS, PRIMARY BATTERIES, STORAGE BATTERIES, LARGE AND SMALL MOTORS, and all ELECTRIC LIGHT GOODS.

The Stout, Meadowcroft Co.,

Authorized Agents for the
EDISON LAMP CO.,
21 & 23 ANN ST.,
P.O. Box 2411. New York.
SEND FOR CATALOGUE.

MODEL and EXPERIMENTAL WORK A SPECIALTY. Send for Circulars. C. E. Jones & Bro. CINCINNATI, O. (Mention this Paper.)

MAYO ELECTRIC MFG. CO.,

160 Portland St., Boston, Mass.

CONTRACTS MADE FOR
Arc & Incandescent Plants
Of the most Improved Description.
CONTRACTORS FOR WIRING, ETC.
Estimates Cheerfully & Promptly Furnished.

OKONITE

CHARLES A. CHEEVER, President. WILLARD L. CANDEE, Treasurer.
THE OKONITE COMPANY,
Formerly New York Insulated Wire and Vulcanite Co.,
MANUFACTURERS OF
INSULATED WIRES AND CABLES,
No. 13 PARK ROW, NEW YORK.

UNION SQUARE HOTEL,
AND HOTEL DAM,
HEADQUARTERS:
Telephone, Telegraph and Electric Light People.
A. J. DAM & SON, Proprietors,
Union Square, cor. 15th Street, New York.

The Bergmann 'Telephone' Battery.

THE BEST
Open-Circuit Battery
IN THE MARKET.

Superior to the Leclanché & all others for Telephone Work, Annunciators, Burglar Alarms, Gas Lighting, etc., etc., in short for all kinds of open circuit work.

PRICE, (complete) $1.00.

Liberal Discount to dealers and large consumers.

Send for Circular and Price List.

BERGMANN & COMPANY,
Electrical Works,
292, 294, 296, 298 Ave. B, New York, N. Y.

Gonda (formerly Prism) Battery, Complete.
See that above label is on every jar

LECLANCHÉ GONDA BATTERY

(FORMERLY THE PRISM BATTERY).

THE STANDARD OPEN CIRCUIT BATTERY OF THE WORLD.

In order to protect our customers, the public and ourselves against unscrupulous piracy of our title, Prism, and its application to worthless imitations of our Battery, we have changed its name to Gonda, which is fully protected by the following

TRADE
GONDA.
MARK.

Buy none without the above Trade-Mark and the label, as shown in cut. The United States Courts have decided this label to be exclusively ours. No one else can use it.

No Battery, whether of Prism or Disque form, is genuine without both label and Trade-Mark.

The *Genuine* Leclanché Prism and Disque Cells are made *only* by us.

THE LECLANCHÉ BATTERY CO.,
149 West 18th Street, New York.

Standard ✣ Electrical ✣ Works,

MANUFACTURERS OF

TELEGRAPH AND TELEPHONE APPARATUS,

Hotel and House Annunciators, Burglar Alarms,

CALL BELLS, "POST'S" MAGNETO BELLS,

PINS and BRACKETS, BATTERIES, &c., &c.

IN STOCK:—FULL LINE

IRON, STEEL and HARD-DRAWN COPPER WIRE, Delivered at Lowest Prices.

☞ ESTIMATES FURNISHED. SEND FOR CATALOGUES AND PRICES. ☜

Cincinnati, Ohio, U. S. A.

FOREST CITY

CARBON MFG. COMPANY,

CLEVELAND, OHIO.

MANUFACTURERS OF

CARBONS

FOR ELECTRIC LIGHTING.

QUALITY GUARANTEED.

HOLMES, BOOTH & HAYDENS,

SOLE AGENTS,

NEW YORK AND BOSTON.

The Thomson-Houston Electric Company.

SOLE OWNERS AND MANUFACTURERS OF THE

ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Lighting in the World.

ALL OUR PATRONS TESTIFY THAT THE BEST IS THE CHEAPEST.

Owing to the Automatic and Self-Regulating features of this Apparatus—broad and valid patents for which are owned by this Company—sufficient saving is effected in power, attendance, and repairs, as compared with any other system, to more than pay interest on the entire cost of plant.

LOCAL LIGHTING COMPANIES CANNOT AFFORD TO OPERATE ANY OTHER SYSTEM.

We are prepared to supply Local Companies, Mills, Railroads, etc., with dynamos running from **one to sixty lights** each, and the largest machine is so perfectly controlled by its Automatic Regulator that it runs safely and economically at full speed with any number of lights below its maximum.

We furnish Arc Lights of various degrees of illuminating capacity, from 1,200 to 4,000 candle power.

We would call especial attention to our New Self-Regulating Divided Arc, which is a novel and valuable feature in our system, and for which there is a very large demand. It is the only practicable and perfect-working Small Arc yet offered to the public, and will effect a great reduction in the cost of Arc-Lighting plants, and very great increase in the efficiency and profits of local companies.

We have established between thirty and forty local companies during the past year, and many more are being organized.

We request capitalists who contemplate putting in an Electric Light Plant to confer with either the Boston or Chicago office before adopting any other system.

Correspondence with active, energetic men, capable of interesting capital and organizing local companies, is solicited.

New illustrated Pamphlet, Price-List, etc., will be furnished on application. Address,

THE THOMSON-HOUSTON ELECTRIC CO.,

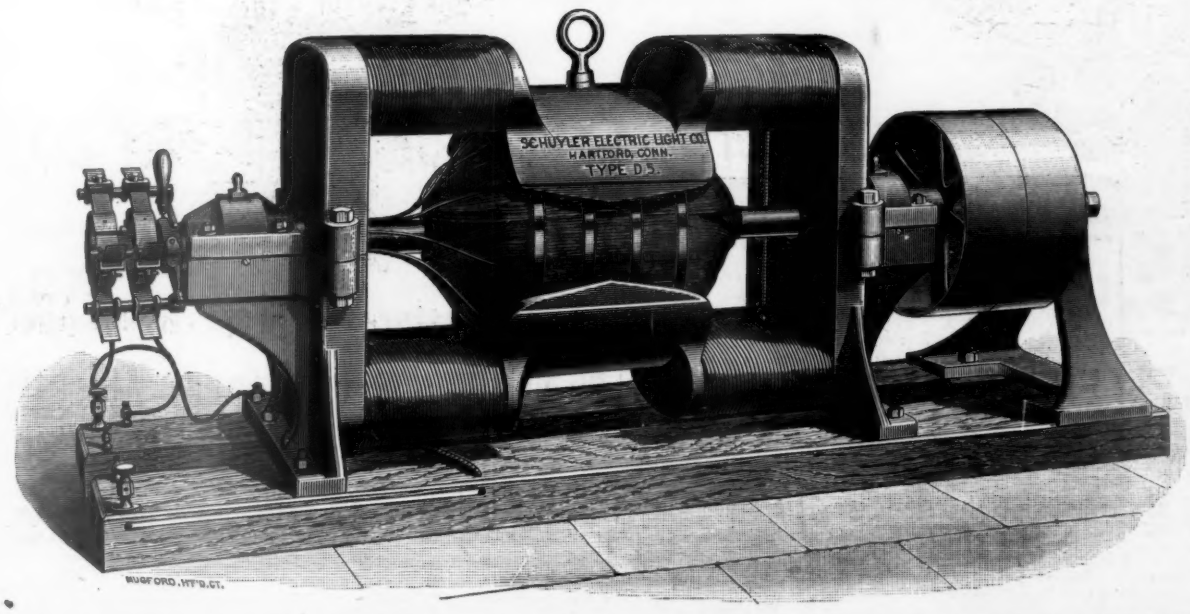
131 DEVONSHIRE STREET. BOSTON, MASS.

SCHUYLER ELECTRIC LIGHT CO.,

MANUFACTURERS OF

DYNAMO MACHINES AND LAMPS

FOR INCANDESCENT AND ARC LIGHTING.



The most perfect system of Arc and Incandescent lighting.

Entire freedom from hissing and flickering in our Arc Lights, and long life and great brilliancy in our Incandescent Lights.

Dynamo Machines with perfect automatic regulation, reliable and efficient.

Prices moderate.

Estimates made for lighting from Central Stations or for isolated plants.

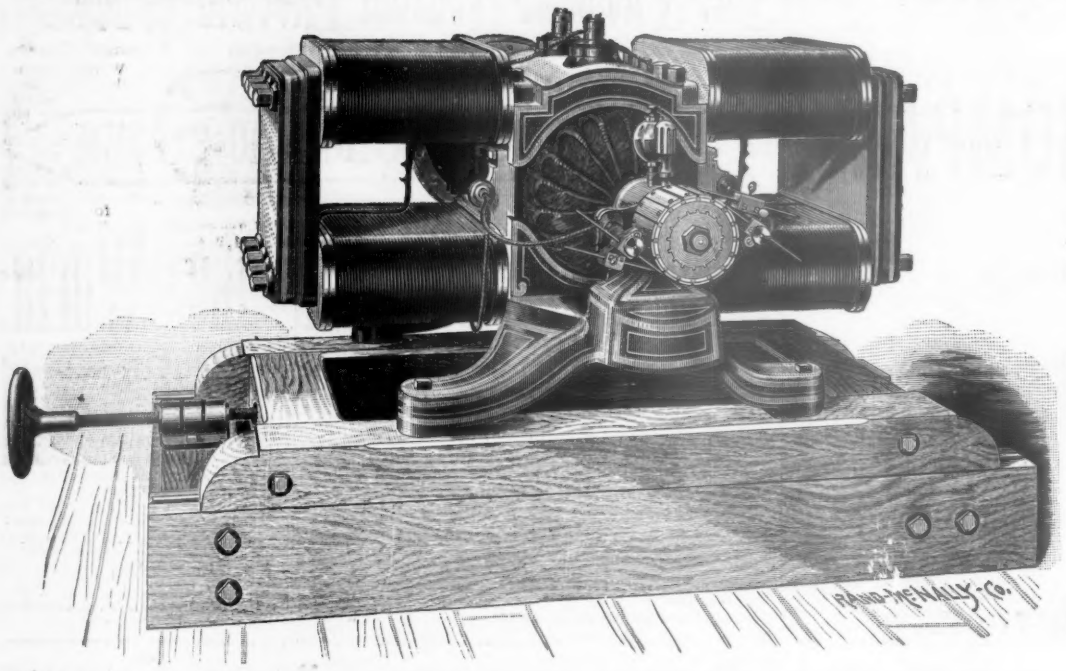
Illustrated circulars sent upon application.

ADDRESS,

SCHUYLER ELECTRIC LIGHT COMPANY, HARTFORD, CONN.

NEW YORK OFFICE, - - - 44 BROADWAY.

WESTERN ELECTRIC COMPANY'S ELECTRIC LIGHTING APPARATUS



Every requisite for the most perfect system of Electric Lighting, at prices which insure a profitable investment to the purchaser.

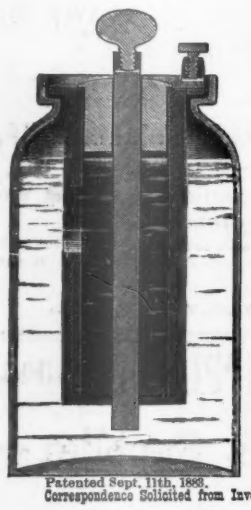
ADDRESS,

Western Electric Company,

CHICAGO OR NEW YORK,

MANUFACTURERS OF AND DEALERS IN ALL KINDS OF

Electrical Apparatus and Supplies.



"Little Giant" Battery.

UNEQUALED FOR

GAS LIGHTING, BURGLAR ALARM, TELEPHONE, ELECTRIC BELL, ANNUNCIATOR AND CLOCK WORK,

Or any Service to which an Open-Circuit Battery can be Applied.

Cannot be destroyed by short circuit. Carbons practically indestructible, as they can be renewed by simply washing in pure water. Great saving in number of cells required as compared with any Open-Circuit Battery now in use. Can be sealed if desired. *Try it and be convinced.*

PRICE, $1.25 PER CELL.

LIBERAL DISCOUNT TO DEALERS AND LARGE CONSUMERS.

RHODE ISLAND TELEPHONE AND ELECTRIC CO.

PROVIDENCE, R. I.

P. O. BOX, 1197.

Patented Sept. 11th, 1883.
Correspondence Solicited from Inventors or others desiring to Patent or Introduce Electrical Novelties of Merit.

THE GRAND RAPIDS

Electric Light and Power Com'y,

Sole Manufacturers of the

THOMAS ELECTRIC LIGHTING APPARATUS.

Fully Protected by Patents.

The THOMAS ARC LAMP is the Simplest, Surest and Most Effective Arc Lamp now extant. It possesses all the advantages of the best Lamps in use, and is less complicated than any. It cuts OUT AND IN automatically. Adapted and made to fit the current of any style of generator.

The THOMAS INCANDESCENT SYSTEM, by means of which incandescent lamps can be operated on the same circuit with arc lamps economically and with perfect safety. This system has been in successful operation for nearly two years at Grand Rapids, Mich., and is now being extensively introduced throughout the country.

For particulars in regard to any of the above apparatus, address the above company at GRAND RAPIDS, MICH.

DORSETT'S UNDERGROUND CONDUIT SYSTEM.

Electrical Insulator, Water, Gas and Sewage Proof! Absorbs no Moisture! Frost Cannot Affect It!

CRUSHING STRAIN, 5,500 LBS. PER SQUARE INCH—GOVERNMENT TEST.

A Complete, Comprehensive System of Conduits for Electric Light, Telegraph, Telephone and Private Wires and Cables for Rental Purposes.

The 2¼-inch ducts in this Conduit are leased to different companies, which may then occupy them with such wires and cables as they may adopt. New wires may be introduced or old one replaced through these ducts between the man-holes as shown in the cut.

An experience of six years for Underground Drainage has shown the superiority of this material as a resistant of moisture, and its consequent immunity from damage by frost. It has been in use for electrical purposes the past winter in the solidly frozen streets of Chicago without injury; is the system used by that city, giving perfect, unbounded satisfaction, and is now being introduced into the cities of St. Louis, Cincinnati and Detroit. The whole body of the Conduit is a thoroughly reliable insulator, unaffected alike by acids and alkalies. The cheapest and most perfect Conduit in the market to-day.

☞ **CORRESPONDENCE SOLICITED.** ☜

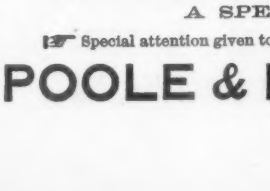
D. H. DORSETT, Proprietor, No. 61 La Salle Street, Chicago, Ill.

ROYCE & MAREAN,
DEALERS IN
ELECTRICAL APPARATUS,
Telegraph and Telephone Supplies,
No. 1408 Penna. Avenue,
Opp. Willard's Hotel, **WASHINGTON, D. C.**

H. M. RAYNOR,
No. 25 BOND ST.,
NEW YORK.
Established 1859.
PLATINUM IN
All Forms FOR
ALL PURPOSES,
WHOLESALE AND RETAIL.

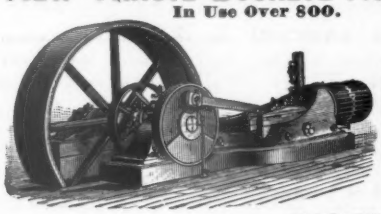
Electric Light.
HENRY C. REES,
730 Sansom St., Philadelphia, Pa.,
Undertakes the Furnishing and Erection of Electric Light Plants of every system.
Incandescent Wiring and Repairs to Dynamos and Lamps a specialty.
Estimates furnished on application.

JARVIS ENGINEERING CO.
BOSTON.
Boilers set with the **JARVIS PATENT FURNACE** to burn Pea Coal, Screenings or Slack without a Blower.
Send for Circulars.



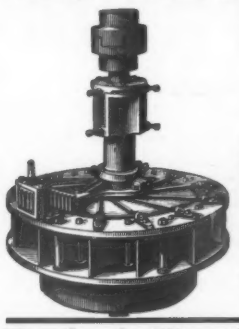
REMINGTON
Standard Type-Writer.
Ask for Particulars Regarding the Use of the Remington Type-Writer in Receiving Messages.
WYCKOFF, SEAMANS & BENEDICT, 339 Broadway, New York.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.
In Use Over 800.
25 to 1,000 H. P.



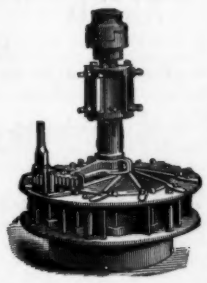
These Engines are the combined result of long experience with automatic cut-off regulation and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-Contained Automatic Cut-off Engines. 12 to 100 H.P. for driving Dynamo Machines a SPECIALTY.—Illustrated Circulars with various data as to practical Steam Engine Construction and performance, free by mail. Address
BUCKEYE ENGINE CO., Salem, O.
SALES AGENTS:
Geo. A. BARNARD, 70 Astor House, N. Y., and 53 Mason Building, Boston, Mass.
D. L. DAVIS, 84 S. Canal St., Chicago, Ill. and ROBINSON & CAREY, St. Paul, Minn.

James Leffel's IMPROVED **WATER WHEEL.**



Made by JAMES LEFFEL & CO.
The "OLD RELIABLE" with Improvements, making it the **Most Perfect Turbine now in use,** comprising the **Largest** and the **Smallest** Wheels under both the **Highest** and **Lowest** Heads in this country. Specially adapted for running Electric Dynamos on account of the great steadiness of its motion. Our new Pocket Wheel Book sent free. Address
JAMES LEFFEL & CO.,
Springfield, Ohio, - AND - 110 Liberty St., New York.
[Please mention this paper when your write to us.]

Poole & Hunt's Leffel Turbine Water Wheel.
Made of Best Materials and in the Best Style of Workmanship.
MACHINE-MOLDED MILL GEARING,
From 1 to 20 feet diameter, of any desired face or pitch, molded by our own special machinery.
SHAFTING, PULLEYS AND HANGERS
Of the latest and most improved designs.
Transmission Machinery
A SPECIALTY.



☞ Special attention given to Heavy Gearing. Shipping facilities the best in all directions.
POOLE & HUNT, Baltimore, Md.

THE AMERICAN BELL TELEPHONE CO.
95 MILK STREET, BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.
The transmission of Speech by all known forms of Electric Speaking Telephones infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof, and liable to suit therefor.

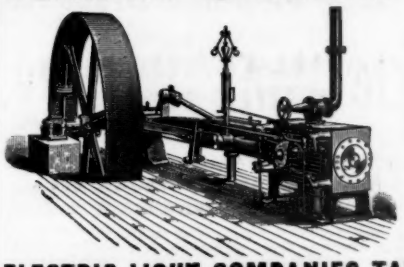
Incandescent Lamps,
From 8 to 150 C. P. (Battery Lamps from 1-2 to 8 C. P.) made in large quantities at short notice.
ADDRESS,
SUN ELECTRIC LIGHT CO.,
WOBURN, MASS.

Automatic Cut off ENGINES
Embodying a New System of Regulation. The Governor Weighs the Load
The most perfect Governing ever obtained. Send for Circular F.
BALL ENGINE CO. ERIE, Pa.
WE GUARANTEE better regulation than it is possible for any other ENGINE to give.

SHEPARD'S $60. CELEBRATED
SCREW CUTTING FOOT LATHE.

Foot and Power Lathes, Drill Presses, Scrolls, Saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, &c. Send for catalogue of outfits for amateurs or artisans. Address,
H. L. SHEPARD, Agt.,
134 E. SECOND STREET, CINCINNATI, O.

HARRIS-CORLISS STEAM ENGINE
BUILT BY
WILLIAM A. HARRIS,
PROVIDENCE, R. I.



From 10 to 2000 Horse Power, with Harris's Improvements. These Engines are of
UNEXCELLED WORKMANSHIP,
and are known the world over as the
MOST ECONOMICAL STEAM ENGINE BUILT.
ELECTRIC LIGHT COMPANIES TAKE NOTICE! They are especially adapted for all purposes where continuous service at uniform speed is required and at the minimum of cost of repairs.
Send for a copy of Engineers' and Steam Users' Manual by J. W. Hill, M. E. Price, $1.25.

CHICAGO, **RAILWAY TELEGRAPH SUPPLY CO.** ILLINOIS.
Manufacturers of
Telegraph Instruments & Supplies.
Our Shop is now Fully equipped for Turning Out all kinds of
ELECTRICAL SUPPLIES, and in any Quantities. Special or Experimental Work promptly done. We can furnish FROM OUR STOCK
Telegraph and Telephone Wires, Telegraph Instruments and Supplies, Electric Light Supplies, Battery Materials and Batteries Complete, Electric Gas Lighting Apparatus, Electric Bells, Telephone Supplies, &c.
TWO OF OUR LEADING SPECIALTIES ARE MAGNETO BELLS AND ANNUNCIATORS.
ADDRESS:
RAILWAY TELEGRAPH SUPPLY CO.,
UNION and FULTON STS., CHICAGO.
PLEASE MENTION THIS PAPER.

Electric Light Globes,
Manufactured by
NEW ENGLAND GLASS WORKS, BOSTON, MASS.
Send for Price List.

VICTOR
Turbine Water Wheel.
The attention of **Electric Companies** is called to this **celebrated water wheel** as particularly adapted to their use, on account of its **remarkably steady motion, high speed** and **great efficiency,** and **large capacity** for its **diameter,** being **double** the **power** of most **wheels** of **same diameter.** It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect, **guaranteed.**
SEND FOR CATALOGUE AND PARTICULARS.
STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.
(Please Mention this Paper.)

"OTTO" GAS ENGINE
OVER 10,000 IN USE.
Started Instantly by a Match.
When Stopped all Expense Ceases.

Works without boiler, steam, coal, ashes or attendance. Successfully adapted instead of steam power in all industries and offers special advantages for running electrical machinery for Telegraph and Telephone as well as Lighting purposes.
Built in Sizes of 1, 2, 4, 7, 10, 15 & 25 ind. H. P.
SCHLEICHER, SCHUMM & CO.
N. E. cor. 33d & Walnut, Phila.
Branch Office: 214 Randolph Street, Chicago.

WORK SHOPS
WITHOUT STEAM POWER
BY USING OUTFITS OF
Barnes' Pat. Foot-Power

machinery can compete with steam power. Sold on trial. Metal and wood workers send for prices. Illustrated catalogue free.
W. F. & JNO. BARNES CO.,
Address No. 1995 Main St. Rockford, Ill.

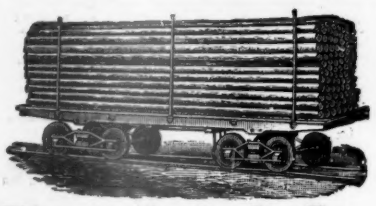
Telegraph and Electrical SUPPLIES
Medical Batteries, Inventors' Models, Experimental Work, and fine brass castings. Send for catalogue C. E. JONES & BRO. Cincinnati, O.
It is important to us that you mention this paper.

TRIPLEX INSULATED
Wire and Rubber
COMPANY.

Superior Quality of Insulation

ON ALL CLASSES OF ELECTRIC WIRES.

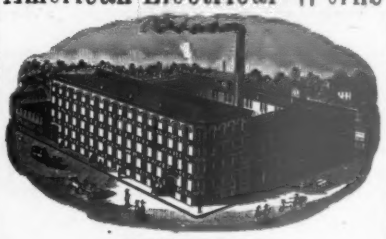
ADDRESS,
159 FRONT ST., NEW YORK CITY.



Brownlee & Co.,
DETROIT, MICH.
DEALERS IN
Cedar Telegraph Poles
MANUFACTURERS OF
Cross Arms, Pins and Brackets,
OAK AND LOCUST PINS,
BROWNLEE'S CONCAVED BRACKET.

(Patent applied for.) Send for Catalogue.

American Electrical Works



MANUFACTURERS OF
Patent Finished Insulated
Electric Wires,
TELEPHONE AND ELECTRIC CORDAGE,
ELECTRIC LIGHT WIRE
MAGNET WIRE.
PATENT RUBBER COVERED WIRE, OFFICE AND ANNUNCIATOR WIRE, LEAD-ENCASED WIRE ANTI-INDUCTION AERIAL AND UNDERGROUND CABLES ETC., ETC.
OFFICE AND FACTORY:
No. 67 STEWART STREET,
PROVIDENCE, R. I.
EUGENE F. PHILLIPS, President.
W. H. SAWYER, Secretary and Electrician

WHITE
Oak Pins and Brackets
OF OUR OWN MANUFACTURE.
TELEPHONE SWITCHBOARDS,
ELECTRIC BELLS,
MEDICAL BATTERIES,
AND A FULL SUPPLY OF
Covered Wires and Electric Sundries
ALWAYS ON HAND.
Send for Catalogue.
DETROIT ELECTRICAL WORKS,
Cor. 7th and Woodbridge Streets,
DETROIT, MICH.

I. W. COLBURN & Co. MFG. OF
Dynamo-Electric Machines
Fitchburg, Mass. SEND FOR CATALOGUE

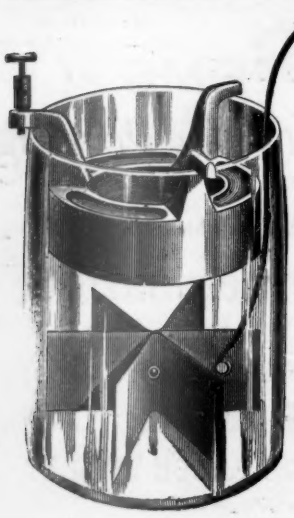
MAGNETO SIGNAL BELLS.
No Battery Required.

"STANDARD."

$4, $6, and upwards, according to style desired.
Discount on large lots.

We make a specialty of the manufacture of these bells for Telephone Companies, and after an experience of many years, our facilities for the prompt execution of large orders are unequaled.
Close attention given to furnishing samples for special orders.

VIADUCT MANUFACTURING CO.
OF BALTIMORE.
A. G. DAVIS, President. A. B. PROAL, Secy. & Treas.
Office, North-West Corner Charles and German Streets,
ELECTRICAL GOODS OF EVERY DESCRIPTION.
Telephone, Telegraph, Electric Light, Fire Alarm and District Telegraph Supplies.
SEND FOR ILLUSTRATED CATALOGUE.



THE MORRISON
Gravity Battery

THE ONLY RELIABLE CLOSED-CIRCUIT BATTERY IN EXISTENCE.

After thirty years' experimenting with other batteries, The Gamewell Fire Alarm Telegraph Co. adopted it as their standard.

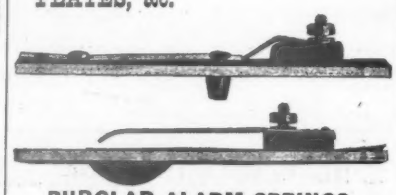
OFFICE OF THE GAMEWELL FIRE ALARM TELEGRAPH CO.,
1½ BARCLAY ST., NEW YORK CITY.
NEW YORK, August 14th, 1885.

THE SOUTHERN ELECTRIC CO., BALTIMORE, MD.
Gentlemen:—We have adopted the "MORRISON GRAVITY BATTERY" as the Standard Fire Alarm Battery for this company's service. After thirty years' experience we unhesitatingly endorse it as the best form of Gravity Battery ever devised.
Yours very truly, J. N. GAMEWELL,
General Superintendent Gamewell Police & Fire Alarm Telegraph Co.

Manufactured only by
THE SOUTHERN ELECTRIC CO.,
Warerooms, Hoen Building, cor. North and Lexington Sts.;
Works, cor. Constitution and Monument Sts.,
BALTIMORE, MD.

ZINCS

LECLANCHE ZINCS, with thumb screw or patent spring connections, from pure spelter, and well amalgamated.
BUNSEN BATTERY ZINCS; MEDICAL BATTERY ZINCS; ZINC PLATES, &c.



BURGLAR ALARM SPRINGS,
A new and reliable spring, with rubbing contacts, open or closed circuits.
Electric Bells of every description. Batteries & Supplies.
The Conn. District Telegraph & Electric Co.,
32 Bank St. - - - - - - Waterbury, Conn.

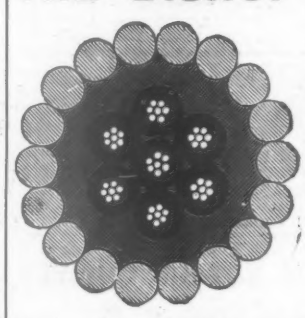
Telegraph and Electrical SUPPLIES
Medical Batteries, Inventors' Models, Experimental Work, and fine brass castings. Send for catalogue C. E. JONES & BRO. Cincinnati, O.
It is important to us that you mention this paper.

PHOSPHOR-BRONZE
TELEPHONE WIRE,
Insulated and Bare.

"Phosphor-Bronze."
Combines High Electrical Conductivity and Resistance to Corrosion with Lightness and Tenacity.
Standard Sizes, 16, 17, and 18, Stubs' Gauge.
ADDRESS;
The Phosphor-Bronze Smelting Co. (limited,)
512 ARCH ST., PHILADELPHIA, PA.
Owners - of - the - United - States - Phosphor-Bronze - Patents.
Sole Manufacturers of Phosphor-Bronze in the United States.

J. F. MORRISON. D. H. TUXWORTH.
Southern ∴ Electric ∴ Co.
BALTIMORE, MD.
Electric Light, Telegraph and Telephone
SUPPLIES.
Special department for experimental work and models. A foundry, especially for brass and zinc castings, is attached to this department. Estimates for work in all departments promptly furnished.
Warerooms: Cor. North & Lexington Sts.
Shops and Foundry: Constitution St., near Monument.

THE BISHOP GUTTA-PERCHA CO.,
420 to 426 East 25th St., N. Y.,
Have improved machinery and increased facilities for making
Submarine, Subterranean and Aerial Cables.



We guarantee our productions
TO BE SUPERIOR TO ANY IMPORTED,
and to sell at prices which will render importation unnecessary. All the *GUTTA-PERCHA* insulated cables made in this country have been manufactured at our works.
All kinds of Insulated Wires at the Lowest Prices.
PURE GUTTA-PERCHA FOR ALL PURPOSES.
W. W. MARKS, Supt. HENRY A. REED, Sec'y.

THE CALLENDER
Insulated Wires and Cables
For OVERHEAD, UNDERGROUND and SUBMARINE PURPOSES.
Further Information on Application.
THE ELECTRICAL SUPPLY CO.
175 & 177 LAKE STREET, CHICAGO.

MODEL and EXPERIMENTAL WORK A SPECIALTY.
Send for Circulars.
C. E. Jones & Bro.
CINCINNATI, O.
(Mention this Paper.)

THE NATIONAL
Time Regulating Company
Is now prepared to contract with **Telephone Companies** in the United States for the use of its instruments for sending **accurate time** signals **by telephone** every minute of the day or night.
By **one instrument** in an exchange any number of subscribers in that exchange can be furnished with accurate time at a *nominal price* per year.
No change in subscribers' instruments required. Does not interfere with conversation. The subscriber simply listens at the receiver, without calling, and the signals are plainly audible. For full particulars, please address
LOREN N. DOWNS, Treasurer,
BOX 1351, BOSTON, MASS.

E. W. HAZAZER,
MANUFACTURER OF
ELECTRIC BELLS

Annunciators, Window Springs, Burglar Alarms, and Gas Lighting Apparatus.
Electric Bells for Residences and Hotels a Specialty.
Model Work Neatly Done.
E. W. HAZAZER,
33 MURRAY STREET, NEW YORK.

ALFRED F. MOORE,
MANUFACTURER OF
Insulated Wire,
For Telephone, Telegraph and Electric Light.
OFFICE, LINE,
AND
ANNUNCIATOR WIRE,
Magnet Wire and Flexible Cordage,
200 & 202 N. THIRD ST.,
PHILADELPHIA, PA.

BOULTON CARBONS

These carbons are made of the
BEST MATERIALS,
and with the latest improved machinery, of **any required degree of hardness,** and can be used in all makes of Electric Lamps.
The regular sizes, 12 inches long, run from ¼ inch to 1 inch diameter, varying by sixteenths.
Special LENGTHS and SIZES to Order.
A large and complete stock always on hand.
The want of a high order of battery plate has long been felt. Those wishing such would do well to use the
BOULTON PLATES.
Special attention is given to the manufacture of all sizes to order.
Price Lists and full information furnished on application.
Also Exclusive Agents of the celebrated
AUSTRIAN Cored CARBON
for the United States.

BOULTON CARBON WORKS,
Foot of Wilson Avenue,
CLEVELAND, OHIO.

Telephone Stocks
—AND—
Chicago Local Stocks & Bonds
BOUGHT AND SOLD
On Commission by the Undersigned.
S. G. LYNCH,
144 La Salle St., Chicago (formerly Lynch & Banta).

ELECTRIC MFG. CO.
Troy, N. Y.
MAKERS OF **STANDARD ELECTRICAL INSTRUMENTS,** AND FINE EXPERIMENTAL WORK
Galvanometers, Resistance Coils, Condensers, Keys, Switches, &c.
BAILEY COMBINATION SET,
PRATT'S SPEED INDICATOR, &c.
SEND FOR CATALOGUE.
ELECTRIC MFG. CO., P.O. Box 80, TROY, N.Y.

STAR IRON TOWER CO.
Manufacturers of the
O'Beirne Patent
TOWERS AND MAST ARMS
FOR
Electric Lighting,
and Publishers of the
AMERICAN ELECTRICAL DIRECTORY
Fort Wayne, Indiana.

CARBONS
FOR ARC LIGHTING.
Only Manufacturers using Natural Gas, thus securing
Uniformity, Durability & Superior Light.
PITTSBURGH CARBON CO., lim'd,
PITTSBURGH, PA.

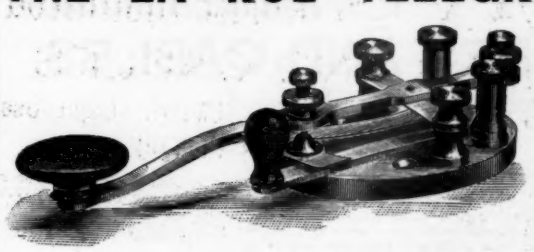
THE WALLACE DIAMOND CARBONS.
The ELECTRICAL SUPPLY CO., 17 Dey St, New York.
And 175 and 177 LAKE STREET, CHICAGO.

STANDARD UNDERGROUND CABLE COM'Y,
Manufacturers of
WARING'S PATENT
Telegraph, Telephone and Electric Light CABLES,
LEAD COVERED WIRE FOR INSIDE USE, PROOF AGAINST DAMPNESS.
No. 128 Pearl St., New York City. {All Work Guaranteed.} No. 88 Fourth Ave., Pittsburgh, Pa.

Consolidated Electric Light Co.,
Owning and Operating the
SAWYER-MAN PATENTS.
THE CONSOLIDATED SAWYER-MAN ELECTRIC LIGHT SYSTEM CO. TRADE MARK
EXECUTIVE OFFICES: Mutual Life Building, NEW YORK.
PHILADELPHIA OFFICE: 205 Walnut Place.
CHARLES H. BANES, President. HUGH R. GARDEN Vice President.
HENRY C. DAVIS, Treas. and General Manager.
Plans and Estimates Furnished for all kinds of INCANDESCENT LIGHTING.
ESTIMATES FURNISHED for the Thomson-Houston System of Arc Lighting.

Schuyler Electric Light Co.,
Manufacturers of
DYNAMO MACHINES
FOR INCANDESCENT AND ARC.
The most perfect system of both Incandescent and Arc Lighting. Entire freedom from hissing and flickering in our Arc Lights, and long life and great brilliancy in our Incandescent Lights.
Dynamo Machines with perfect automatic regulation, reliable and efficient.
Prices moderate. Estimates made for lighting from Central Stations or for isolated plants. Illustrated Circulars sent upon application. Address
New York Office: 44 BROADWAY.
SCHUYLER ELECTRIC LIGHT CO.,
Hartford, Conn.

HENRY B. LYTLE. GEO. L. BEETLE. FRANK B. KNIGHT.
LYTLE AND COMPANY,
15 CORTLANDT STREET, NEW YORK.
MANUFACTURERS' AGENTS.
Electrical Supplies and Apparatus
OF EVERY DESCRIPTION.
LICENSEES
TELEGRAPHIC TIME COMPANY
In States of New York, New Jersey, Penn., Ohio, Indiana, Missouri, Wisconsin, Minnesota and Kansas.
Information Furnished Upon Application.

THE LA RUE TELEGRAPH KEY.

Pronounced by all users the
Most Perfect Key
EVER DEVISED.
Price, $2.50.
ABSOLUTELY
No Side Motion, No Sticking, No "Wabbling," No Retractile Spring, No Trunnions, the Least Number of Wearing Parts of any Key Manufactured.
STEEL LEVER AND VERY BEST WORKMANSHIP THROUGHOUT.
The most severe tests by the Western Union, Baltimore & Ohio, and Postal Telegraph Companies, and the flattering recommendations received from superintendents, managers and operators, justly entitle the LA RUE KEY to the superior merits claimed for it.
A circular with full particulars upon application.
LYTLE & CO., Sole Agents, 15 Cortlandt St., N. Y.

MODEL and EXPERIMENTAL WORK A SPECIALTY. Send for Circulars. C. E. Jones & Bro. CINCINNATI, O. (Mention this Paper.)

B. TROPP,
The Cheapest House in the Trade for
ELECTRIC BELLS,
RUHMKORFF SPARK COILS.
285 Atlantic Avenue, Brooklyn, L. I.

THE
United States Electric Lighting Co.
SOLE MANUFACTURERS OF
WESTON
DYNAMO MACHINES
FOR BOTH
Arc and Incandescent Lighting and Electroplating.
WESTON ARC LAMPS,
Weston Incandescent Lamps,
ELECTRIC MOTORS, AUTOMATIC REGULATORS,
Fixtures, Fittings, &c.
THE WESTON SYSTEMS OF
Arc and Incandescent Lighting
ARE SUPERIOR TO ALL OTHERS IN
EFFICIENCY, SAFETY, RELIABILITY AND
Perfection of Automatic Regulation.
Full information with prices and Estimates furnished upon application.
General Office, 59 & 61 Liberty St., New York.
Chicago Office, 185 LA SALLE STREET.

TELEGRAPHIC TIME COMPANY,

14 & 15 TEMPLE COURT, 5 BEEKMAN ST.

NEW YORK.

OWNERS OF PATENTS COVERING THE ONLY COMPLETE ELECTRIC TIME SYSTEM, WHICH HAS BEEN SUCCESSFULLY OPERATED ON AN EXTENSIVE SCALE, IN THE WORLD.

THIS Company, recently organized, has acquired all the Patents and Contracts of the TIME TELEGRAPH COMPANY and a large number of valuable and entirely new base patents covering Electro-Mechanical Clocks and Synchronizing Devices. Two years of service in New York, Boston, Providence and other large New England Cities have demonstrated the perfect reliability of this System. Highest testimonials at the Philadelphia Electrical Exposition and from Electrical Experts and practical Clock Manufacturers and Dealers, also from subscribers who are using the System in 20 of the prominent cities of the United States.

TERRITORIAL RIGHTS FOR SALE UPON LIBERAL TERMS. CORRESPONDENCE SOLICITED IN RELATION TO THE INTRODUCTION OF THE BUSINESS INTO PORTIONS OF THE UNITED STATES FOR WHICH LICENSES HAVE NOT BEEN GRANTED.

38 Conductor Aerial Telephone Cable.

DAY'S Kerite Insulated WIRES AND CABLES

For Telephone, Telegraph and Electric Light Use and Electrical Circuits Generally.

The reliability and durability of Kerite Insulation is unsurpassed, as has been proven by years of experience. All rubber and gutta-percha compounds are very short-lived when placed either in the air or underground, and the supposed new insulating materials now being presented to the public, are most of them old and discarded experimental products. The present high standard and uniform quality of Kerite is the result of 30 years' experience.

The attention of TELEPHONE MANAGERS is especially asked to our ANTI-INDUCTION TELEPHONE CABLES, they being the most practical and durable in the market.

TELEGRAPH, TELEPHONE and ELECTRIC LIGHT Wires, for either SUBMARINE or UNDERGROUND work a specialty. Estimates for complete systems of underground wires and conduits will be furnished on application.

AUSTIN G. DAY, Sole Manufacturer.

CLARK B. HOTCHKISS, Gen'l Agent,

120 BROADWAY, NEW YORK.

THE BEST IS THE CHEAPEST.

The Brush-Swan Electric Light Co. of New England

W. L. STRONG, President. C. P. WHITNEY, Secretary.
A. D. JUILLIARD, Vice-President. R. W. ABORN, Treasurer.
JOHN B. POWELL, General Manager.

REMOVED TO Nos. 204, 206, 208, 210 ELIZABETH ST., NEW YORK.

WHERE ELECTRICAL APPARATUS FOR ALL THE VARIOUS MODES OF LIGHTING AND TRANSMITTING OF POWER ARE IN OPERATION.

NO OTHER SYSTEM IS AS ECONOMICAL IN INSTALLATION AND MAINTENANCE.

NO OTHER ELECTRIC LIGHT APPARATUS IS AS DURABLE.—THE FIRST MACHINES MADE ARE STILL IN DAILY OPERATION.

THE SYSTEM COMPRISES:
- Arc Lights of various Sizes.
- Arc and Incandescent Lights from one Dynamo and Circuit.
- Incandescent Lights of various Sizes from Special Dynamos for Central Station Lighting.

Cost of Apparatus Greatly Reduced. Surveys and Estimates Furnished by Experts.

This company owns and controls all the Patents for ARC LIGHTING issued to CHAS. F. BRUSH, of Cleveland, for the New England States, New York, Pennsylvania, New Jersey, Delaware, Maryland, and the District of Columbia; also the Swan Patents for the same territory.

G. W. STOCKLY, President. J. J. TRACY, Vice-Prest. W. F. SWIFT, Secretary.
J. POTTER, Treasurer. N. S. POSSONS, Supt. W. A. POSSONS, Asst. Supt.

THE BRUSH ELECTRIC CO.,

The Sole Manufacturers, under all the patents of Charles F. Brush, for Electric Lighting, Storage Batteries, Carbons, Electro-Plating Machines, Electric-Motors, &c.

WE FURNISH the ONLY COMPLETE and PERFECT SYSTEM OF ELECTRIC LIGHTING.

Machines for Arc Lighting, giving lights of 1,200, 2,000, 3,000, 4,000 and up to 100,000 candle power. Our No. 8 machine gives 65 lights of 2,000 c. p. with about 45 H. P.

Over twenty different styles of arc lamps, for indoor and outdoor use, and for tower lighting.

MACHINES FOR INCANDESCENT LIGHTING,

adapted for use with Swan Incandescent lamps. These machines are automatic and do not require the use of any switches or resistances outside of the machine to govern the current. Will run any number of lamps from one up to the full capacity of the machine, without change of speed and without the use of any apparatus outside of the machine.

Our prices are lower than other makers.

Storage Batteries, for Incandescent Lighting and for Electric Motors. Our storage batteries are the only practical ones offered in the market. They are especially adapted for situations where lights are needed for only four or five hours per day and where it is convenient to use power during the day to store up the current. There are thousands of such places where our storage battery must eventually be used.

CARBONS FOR ARC LAMPS.

Our carbons are the purest and best made. We have the largest and most fully equipped carbon factory in the world and our prices are very low.

ELECTRIC MOTORS.

We have commenced the manufacture of the Brush Electric Motors and shall soon be prepared to fill orders for all sizes from one up to forty horse-power. In many locations these are the most economical producers of power and will be largely used by Lighting Companies and others where small powers are required.

THE BRUSH ELECTRIC CO., *104 EUCLID AVENUE, Cleveland, O., U. S., A.*

ANSONIA BRASS & COPPER CO.,

Manufacturers of

Pure Electric Copper Wire,

BARE AND COVERED, OF EVERY DESCRIPTION.

"ACME" BRONZE TELEGRAPH AND TELEPHONE WIRE.

Warerooms: 19 & 21 Cliff St., New York. Factories: Ansonia, Conn.

HOLMES, BOOTH & HAYDENS,

Manufacturers of

Hard-drawn Copper Wire

For Telegraph and Telephone.

Patent Electric Light Wire, Magnet Wire,
Patent "K. K." Copper and Iron Wire, &c.

Sole Agents for the

Forest City Carbon Mfg. Co.

NEW YORK, BOSTON AND PHILADELPHIA. FACTORIES: Waterbury, Conn.

BRIDGEPORT BRASS CO.,

BRIDGEPORT, CONN.,

INCORPORATED 1865.

BRASS, COPPER AND GERMAN SILVER

WIRE AND ROLLING MILLS,

Bare and Insulated Copper Wire for Electric Conductors a specialty.

SOLE AGENTS FOR THE

BRIDGEPORT ELECTRIC MFG. CO.

The Armington & Sims

AUTOMATIC CUT-OFF ENGINE.

For all purposes where power is required.

CLOSE REGULATION,
ECONOMICAL OF FUEL,
SMALL SPACE REQUIRED,
MODERATE PRICE.

Over 1700 Engines in Use.

SELLING AGENTS:

JARVIS ENGINEERING CO., 61 Oliver St., Boston.
POND ENGINEERING CO., St. Louis, Mo.
J. F. RANDALL, Warren, Ohio.
JOHN R. MARKLE, Detroit, Mich.
H. B. SMITH MACHINE CO., 925 Market St., Phil., Pa.
T. W. ANDERSON, New Orleans, La.
E. P. HAMPSON & CO., 36 Cortlandt St., New York.
TANNER & DELANEY ENGINE CO., Richmond, Va.
MORTON, REED & CO., Baltimore, Md.
WM. MINNIGERODE, Atlanta, Ga.

Shultz Belting Company,

MANUFACTURERS OF

SHULTZ PATENT FULLED LEATHER BELTING AND LACE LEATHER.

Office and Factory: Cor. Bismarck and Barton Sts., St. Louis, Mo.

Our Belting is made of leather tanned on the surface only; the interior (which is the fiber and strength of the hide) is not tanned, but rawhide fulled and softened by our patented process. Our Belting is more pliable, hugs the pulley better, transmits more power than any other, and is the only perfect ELECTRIC LIGHT BELT MADE. Agents in all cities. Send for trial belt.

THE ELECTRICAL SUPPLY CO.

MANUFACTURERS OF

Insulated Wire

OF EVERY DESCRIPTION.

(Factory of the Electrical Supply Co., at Lowell, Mass.)

ELECTRIC LIGHT, TELEPHONE, AND TELEGRAPH SUPPLIES.

Warehouses: 17 DEY ST., NEW YORK. 175 & 177 Lake St., Chicago.

Telegraph and Electrical SUPPLIES

Medical Batteries, Inventors' Models, Experimental Work, and fine brass castings. Send for catalogue C. E. JONES & BRO. Cincinnati, O.

It is important to us that you mention this paper.

MITCHELL, VANCE & CO.,

GAS FIXTURE MANUFACTURERS,

Have added a department for the Manufacture of Electroliers and other fixtures adaptable to any system of Incandescent Electric Lighting, also Combination Fixtures for both Gas and Electric Light. Estimates and designs furnished upon application.

836 & 838 BROADWAY,
NEW YORK.